agKnowledge
"The Independent Fertiliser Experts"

Spring
2012

Fertiliser Review

ISSUE 29

AGRISEA

"Those who cannot remember the past are condemned to repeat it." So opined George Santayana (1863- 1952).

The history that has been forgotten is the famous Court Case (Bell Booth Group versus MAF 1987) over a liquid fertiliser called Maxicrop. The company that appears to have amnesia is AgriSea Ltd, a Paeroa company, which makes and sells liquid fertiliser.

Flashback to the early 1980s – fertiliser subsidies were being removed and the cost of fertiliser was increasing rapidly. The Bell-Booth Group, who distributed Maxicrop in New Zealand, seized the moment and launched a very bold advertising campaign promoting Maxicrop. This of course attracted attention and the upshot was a FairGo program on TV1. MAF told the Bell-Booths that Maxicrop did not work. In response they sued MAF for defamation. The Judge later described this action as a "disastrous piece of litigation." After hearing all the evidence from New Zealand and around the world, the Judge ruled that the product could not (based on what it contained) and did not work (based on the trial results).

As I travel around New Zealand I am seeing with greater frequency billboards promoting AgriSea and one assumes by association their liquid seaweed products. Indeed there is one not far from my office in Victoria St, Hamilton.

A quick cruise around their website confirms the same old litany. AgriSea Ltd promotes two liquid seaweeds, Agrisea Pasture Nutrition and Agrisea Soil Conditioner. The chemical analysis provided suggests they are the same. They claim that these products; feed the soil bugs, unlock soil P, improve pasture palatability and enhance animal health. Just how one product can do all these things at once is beyond comprehension but from a marketing point of view they push all the right buttons as far as the farmer is concerned.These products are recommended to be applied to pastures at 5 litres/ha and it is not difficult to work out that at this rate of application they will apply agronomically trivial amounts of nutrients and trace elements.

The composition of these AgriSea products and the claims made for them are very similar to those made for Maxicrop and the many other similar products sold in New Zealand (e.g. Nitrosol and Agrisol) and around the world. For this reason it is reasonable to say they all belong to the same class of product – liquid products derived from organic materials referred to variously as liquid fertilisers, foliar fertilisers, soil conditioners or plant tonics.

Field trials

During the Maxicrop court case I assembled all of the field trial data available internationally on these types of products. Subsequently I wrote a scientific review based on this data (for those interested it is available at "www.agknowledge.co.nz/publications/scientific", papers. In all there were 810 trials. The abstract (summary) of the paper is given below:

Abstract

"The results from field trials measuring the effect of liquid fertilisers derived from organic materials on crop yields are summarized and reviewed. Trials comparing the efficacy of 26 specific products and 2 unnamed generic products were identified. Of these 28 products, 15 were derived from seaweed, 4 from fish waste, 5 were of vegetable origin, and 2 were from animal products. Cereals were the most frequently used test crop (328 recorded treatment effects) followed by root crops (227), legumes (88), pastures (59) and vegetables (52). Fifty-three other treatment effects were recorded on crops such as rape (15), peanuts (8), tobacco (6) and miscellaneous other crops (25). The effects of liquid fertilisers on animal performance was measured in four trials.

The observed effects of these products on a wide range of crops were normally distributed about zero with an equal number of positive and negative "responses". The frequency of statistically significant events, both positive and negative, was consistent with probability theory, assuming the products are ineffective. The range of observed effects are also consistent with the normal variability associated with field trial experimentation, taking into account the odd intrusion of other experimental errors. There was no evidence to support the conclusion that at least some product-types or products were effective on some crop-types, crops or cultivars. Similarly, liquid fertilisers had no effect on animal production when applied as recommended.

This conclusion, based on the field evidence, was consistent with, and could be predicted from, independent evidence showing that these products do not contain sufficient concentrations of either plant nutrients, organic matter or plant growth substances (PGSs) to elicit increases in plant growth when applied as recommended".

Meaning?

Cutting through the scientific jargon what this amounts to is that these liquid fertilisers are as good as the water they contain!

I can hear someone asking – can science be so certain? In this case it can. Figure 1 shows the results from all the field trials reported internationally. The results are presented as a 'cumulative distribution function'. Each point (there are 810 points in this graph) represents the result from 1 trial (plant yield response to a liquid fertiliser as a % of the control).

The measured "responses" (the reason for the "inverted commas" will soon become apparent) are equally distributed around a mean of zero – 50% are above zero and 50% below zero. Now, if a product was having a real and consistent effect on plant growth all the response should be above zero. If the product was effective "more often than not" then there would more responses above zero than below. Clearly this is not the case.

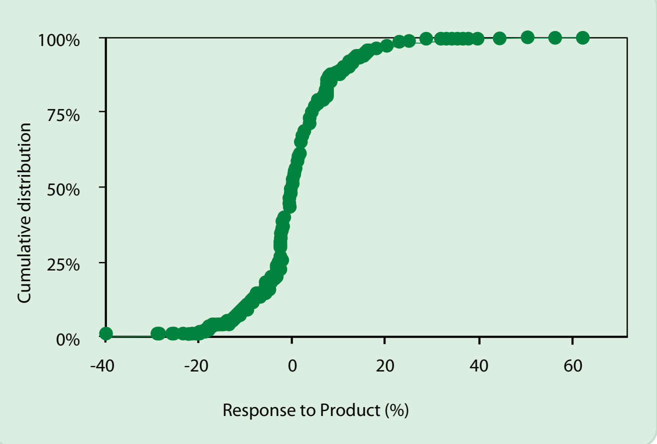

Figure 1: The cumulative distribution of crop responses (% relative to control) to liquid fertilisers.

We can conclude from this that liquid fertilisers have no practical effect on crop yield and that the observed range in the measured "responses", both positive and negative, is simply reflecting the background variation (noise) in the measurements. After all we do not expect that these products can really depress plant growth. If you wish to accept all the positive "responses" as real then you must also accept the negative responses as real.

No better than water

The beauty of looking at the results in this manner is that you can 'see' all the data including the background noise that arises in all biological experiments like this. The key when looking at results in this way is how far the distribution of the responses moves to the right. The further it moves to the right, away from zero, the more effective the product is. Now look at Figure 2.

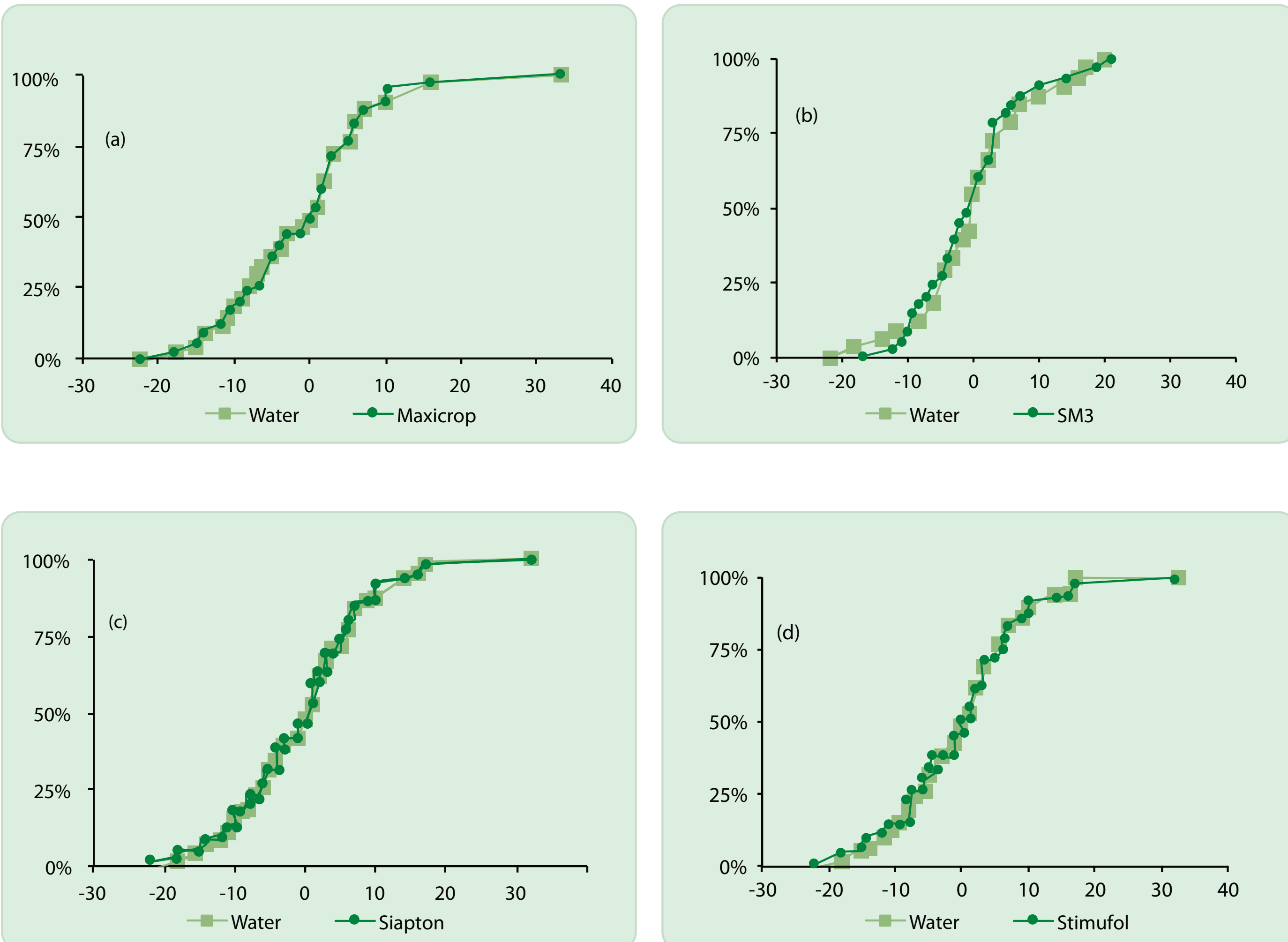

Figure 2: Crop responses (% relative to control) to 4 liquid fertilisers (Maxicrop, SM3, Siapton and Stimufol) and water applied at the same rate as the water in the liquid fertiliser.

These results are from a series of trials conducted by George Wadsworth in the UK. He measured the effects of 4 different liquid fertilisers on a range of crops and sites. There were three treatments 1) control 2) liquid fertiliser (Maxicrop, SM3, Siapton and Stimufol) and 3) water (i.e. the same amount of water as was applied when applying the liquid fertilisers.

Once again we see that the distribution of the "responses" are centered on zero (these products are ineffective) and range from about -20% to +20% (reflecting the background noise). But, and this is the fascinating part, the distribution of the "responses" to the 4 liquid fertilisers are the same as for water! QED. (Quod erat demonstrandum = which was to be proved).

It does not matter what you call these products; soil conditioners, plant tonics, foliar fertiliser or whatever, the fact remains they do not work which means that any claims made on their behalf are false. This would appear to me to be a breach of the Fair Trading Act. Perhaps someone should talk to the Commerce Commission?

In the meantime I suggest you follow the example of the man in the photograph. He followed the advice offered by the late great Professor Walker who quipped, when warning farmers about these products: keep the drum - it is the most useful part!

ALL PADDOCK TESTING (APT) – CHASING TALES

In Fertiliser Review 27, I wrote an article criticizing this new craze. I provided an example showing that APT does not confer any advantages over the conventional approach[1] but costs much more. In the example discussed, $300 (conventional) versus $1600 (APT) and this comparison did not include the cost of time – it takes much longer to sample each paddock.

[[1] In the conventional approach the farm is divided into blocks that represent areas of different soil group, slope, land use and fertiliser history. A representative paddock (s) is then selected within each block and a soil test collected (20 cores 75 mm depth), being very careful to avoid nutrient hot spots – dung and urine patches, stock camps, around troughs, gateways and fences. This approach removes the major source of variation on a given farm]

I have now received a copy of a report prepared for R J Hill Laboratories by agResearch dated July 2009. The results from this report have been used to promote APT in the Dairy Exporter.

The report contains details of a study done on a Northland dairy farm. Three soil-testing strategies were compared as the basis for making fertiliser advice:

1. APT: Each paddock on the farm was soil tested and based on these results fertiliser was recommended for each paddock to achieve an Olsen P of 30-40. If the Olsen P was > 30-40 no fertiliser P was recommended. Maintenance was recommended if the Olsen P was in the 30-40 range, and capital P if the Olsen P was below 30-40.

2. Traditional, Option 1: The farm was divided into blocks (i.e. the traditional approach) and the average Olsen P for each block was used to decide how much fertiliser if any was required using the Olsen P criteria above.

3. Traditional, Option 2: As for Traditional, Option 1, above except that fertiliser P was recommended to maintain the measured Olsen P irrespective of whether it was above or below 30-40.

The fertiliser costs for each strategy were: $36,568 (APT); $8,578 (Traditional, Option 1) and $55,047 (Traditional Option 2).

The question is, which strategy is right? The answer is; none of them!

This study in my view was fatally flawed because all the soil testing was done on a grid basis – soil samples (individual cores) were collected every so many meters. This is most definitely not the way to soil test for the purposes of offering fertiliser advice. The standard soil testing protocol is very clear – do not sample dung and urine patches, do not sample stock camp areas, do not sample near gateways, troughs and fences and hedges. If this protocol is not followed the soil tests results will be biased upwards. The farm will appear to be more fertile than it is. And I see this problem frequently – farms on which the soil tests levels appear to be good but the pastures are terrible.

Setting aside the likelihood that the soil test results are inaccurate (inflated), can anything be taken from this study? Obviously applying fertiliser P when the soil Olsen P levels are above the optimal is unwise (i.e. compare strategy 2 and 3). But we knew that anyway – we did not need this study to work this out. More to the point, comparing Strategy 1 with Strategy 2 suggest that APT can result in greater fertiliser expenditure. To me this highlights the great danger of APT. The variability in Olsen P test levels, under normal circumstances, is about +/-20%. This means that if the reading on your report says Olsen P 35 it could be 29 or 42, but is most likely to be somewhere in the range 29-42 (i.e. +/- 20% of 35). This means that you could retest the same paddock the next day a get a reading 29 or 30 or some other number in the range 29-42. *The problem with APT is that you end up chasing this variability with the fertiliser truck.* What you measured as Olsen P 29 was consistent with a value in the range 35-40, the criteria you used to determine whether fertiliser P was to be applied or otherwise. Without an understanding of soil test variability, you interpreted the Olsen P number literally and applied capital fertiliser to a paddock that probably did not need it. This is the likely reason why the fertiliser costs where higher for Strategy 1 (ATP) and for Strategy 2 (Traditional, Option 1).

As I have said before, APT is a gimmick promoted on dubious grounds to farmers for the benefit of some soil testing laboratories. It is perfectly understandable and legitimate that these laboratories want to increase their businesses but in my view there are more constructive and helpful ways to do so. For example, there are still many farms in New Zealand that are not routinely soil tested. Why not encourage the adoption of more soil testing using the traditional protocols. Why not some educational activities on the do's and don'ts of soil testing? I am sure there is a long list of possibilities.

Reality Check

In an attempt to get some reality into this situation, agKnowledge soil tested the same farm using the standard traditional protocols. Our results are summarized below and they indicate that 3 of the 5 blocks are P deficient and 4 are K deficient. Forget APT – get some capital fertiliser on and get the pasture growing again!

Block	Olsen P	K	Sulphate S	Organic S	Mg	Na	pH
Dairy A	38	4	16	5	32	5	5.9
Dairy B	25	10	42	7	52	6	5.8
White Hills	21	2	25	3	19	4	5.8
Peat	38	6	34	10	41	7	6.1
Smiths Hill	30	6	23	8	37	6	6.1
Average	**30**	**6**	**28**	**7**	**36**	**6**	**5.9**
Optimal	*35-40*	*7-10*	*10-12*	*10-12*	*8-10*	*3-4*	*5.8-6.0*

My Advice If it is not STP (Scientifically Tested and Proven) it is not STP.

HUMATES, FULVATES AND SOIL ORGANIC MATTER

The Department of Primary Industries, NSW, Australia, has just released a comprehensive scientific review of humic products undertaken by Kim Billingham and entitled, “Humic products. Potential or presumption for agriculture.” It is an excellent read for the technically savy. Summarized below, along with some commentary from me, are some of the highlights from the report.

1. The word “humus” was coined by the Romans and it meant quite simply, soil or earth.

2. Prior to our understanding of plant nutrients (i.e. before 1850) it was believed that humus was the ‘life force’ of the soil – it was the active ingredient that made plants grow. It is from this mistaken belief that the modern “Organic Farming” movement owes it origins and continues to cherish the romantic view of the magic of organic matter (see Fertiliser Review 19).

3. From the middle of the 1800s our modern understanding of plant nutrition began to emerge. It is now known that there are 16 essential nutrients (see Fertiliser Review No 16) and that all a plant needs from the soil is a) support to stand in b) a source of water and c) 16 nutrients. This is a fact because plants grow perfectly well in hydroponic solutions providing the plant has physical support.

4. I had been taught that it was von Liebig (1803-1873) who blazed the initial trail to find the essential nutrients, but I now learn from this report that he purloined, without acknowledgment (it is normally called plagiarism), the research of Carl Sprengel (1787-1859).

5. Our modern word for humus is soil organic matter (SOM), which can be categorized into three fractions: humic acid, fulvic acid and humin. What are now popularly referred to and sold as Humates (or Fulvates) are simply chemical derivatives (salts) of humic acid (and fulvic acid). (see for example the article on Abron in this Fertiliser Review).

6. Humic substances are found in all sorts of materials including soils, brown coals, shales, peats and compost. The brown coloration in the water draining our peat soils is due to water-soluble humic materials.

7. There is a large body of scientific literature on humic and fulvic substances (approx. 10,000 articles). In other words, these materials are not a modern invention arising from a newly found desire to become more biological or sustainable, as is sometimes claimed by promoters of these products.
8. While plants do not require SOM to grow (and by definition humates and fulvates), SOM itself has very beneficial effects on soil properties, which indirectly assist plants growing in soils. For example, SOM (and its derivatives) improve soil structure, provides storage for N, P and S and enhance the ability of the soil to hold water and to retain positively charged nutrients; Ca, Mg, K and Na.

9. Many of the claims made for commercially available humate products simply reflect the known beneficial properties of organic matter, as noted above.

Do they work?

Most of New Zealand's pastoral soils contain very large amounts of organic matter. Estimates range from 100 to 300 tonnes per hectare to a depth of 18 cm. (the depth of the A horizon in many NZ soil). Remember, about 50% of this SOM is humic acid and 50% fulvic acid. Thus, the normal benefits of SOM have already been conferred on New Zealand soils. The question from the farmer's perspective is; will adding an additional small amount of humate (typically 25 kg humate/ha) have any additional benefit over and above the 50 to 150 tonnes of humate/ha already present? The answer has to be – most unlikely. Remember too the cost of commercially available humates is about $2500 per tonne.

The report notes that there have been many experiments examining the effects of humic products on plant growth and yield and summarizes the situation as follows: "The major limiting factor of these studies is that most were conducted under controlled laboratory conditions or in glasshouses. The majority used seedlings or young plants in nutrient solutions, growth media or in pot trials. Many were vegetable crops. *Extrapolating these results to agricultural conditions is fraught with difficulties"* (my emphasis).

One of the appealing marketing claims made for Humates (and incidentally most liquid fertilisers derived from organic materials – see earlier article in this issue) is that they feed the soil microbes. Knowing no better, the farmer thinks – "Crikey, this is a new idea, maybe that is why my pastures are looking run-out and are not performing". Within the twinkling of a cash register, he is applying some Humate product at great expense smugly thinking, "now I'm really looking after my soil." BUT, consider this:

Some reality

Lets say you grow 10,000 kg pasture DM/ha per year and the utilisation is 80%. That means there are 2 tonnes of DM/ha being returned to the soil. Some of this is oxidized and lost to the atmosphere, but about 1 tonne/ha is returned to the soil. This is food for the soil bugs and critters, noting that about 50% of it is sugar (carbohydrate). It is exactly for this reason that soil biomass (the sum of all the bugs in the soil) increases with increasing soil fertility – the more you grow above the ground the more you feed the soil biology (see Fertiliser Review No 13).
So if you believe that adding say 25 kg humate/ha over and above the 1000 kg DM/ha going back to the soil as plant residues then it is likely that you still find Santa Claus and the Tooth Fairy interesting. For the rest of you pundits out there trying to make coin, I suggest that humates are not for hue-mate!

INTRODUCING: DR ROBERT MCBRIDE.

Robert has joined the agknowledge team covering the South Island from his home base out of Gore. He has a PhD is soil science from one of the finest agricultural universities in the USA (North Carolina State). He is a Californian by birth but has fallen in love with New Zealand and in particular Southland. After working closely with me over the last 26 months he is now fully up to speed with our New Zealand ways of farming and in particular our clover-based pastoral system. Robert has a unique and refreshing way of looking at soil fertility and plant nutrition as the next article demonstrates.

SOIL PHOSPHORUS RETENTION (contributed by Dr McBride)

[Editorial Note: Soil P Retention is sometimes incorrectly called P fixation. It is the most misused concept in applied soil science. The topic was first discussed in Fertiliser Review No 1 & 2. The message is worth repeating].

The amount of immediately plant available phosphorus (P) in the soil at any given time is small, about 0.3 - 3 kg per ha, By contrast a fast growing crop will take up 1 kg/ha per day. That is, crops can very quickly remove more P from the soil solution than is present. How can this be? How can the plant continue to grow? The answer to the apparent riddle is that there is, in most fertile soils, a large pool of what can be called retained P or “fixed” P that rapidly goes into (and out of) solution.

To help understand this concept, consider what happens when sugar is added to a pitcher (Editorial note: a bucket in our language) of water: as the sugar is poured into the pitcher and stirred, it dissolves and the solution remains liquid. Sugar can be added until the solution becomes saturated at which point any further added sugar will not dissolve and will collect on the bottom.

Now imagine that the pitcher is half full of un-dissolved sugar. The water will be saturated with sugar, and if bees drink half the liquid , the remaining water will still be saturated with sugar. Now consider what happens when the pitcher is once again topped up with water; the solution will no longer be saturated because the added water dilutes it. But this is only a temporary condition because, even without stirring, some of the solid sugar on the bottom of the pitcher will dissolve and go into solution until the water is once again saturated. The process of bees drinking followed by topping up can be repeated over and over, and as long as there is still sugar on the bottom of the pitcher, the water will continue to saturate with sugar. As the solid sugar supply is depleted it will take increasingly longer for the solution to become saturated, and eventually the pitcher will run out of sugar and the water will become increasingly dilute.

Alternatively, if there are no hungry bees, water can still be lost by evaporation. In this case, although there is less water, all the sugar will remain; therefore some of the sugar that was in solution will have to precipitate back out as solid sugar crystals.

The sugar in the pitcher behaves in a similar way to the pool of retained P (or 'fixed P) in the soil. There is a supply of retained P in contact with the soil solution P. The retained P will continue to dissolve and go into solution until the soil solution becomes saturated. As the water content increases or decreases, P will continue to dissolve or precipitate accordingly. It is a bit more complicated in that bees cannot selectively suck the sugar out of the water whereas plants can do that with P to a degree, but the principle is the same; and that is why a crop can take up more P than is in soil solution at any given time.

Many salesmen will tell you that all the P from soluble P fertilizers becomes "fixed" and is lost. This is not true. Most of the soluble fertiliser P added to soils remains, like the sugar, solid but available.

So despite what the salesmen says, the practical implications of soluble P fertilisers becoming rapidly insoluble in the soil is very good for farmers. Some things to consider:

- Retained P is not locked up and lost
- Because there is very little P in the soil solution at any one time leaching of P (as occurs with nitrate) is generally not a problem in New Zealand
- Once the retained P tank is filled up, the amount of retained P is much, much greater than the amount of P removed and hence the timing and amounts of maintenance P fertilization are not critical to keep the system running.
- Because soluble fertiliser P when added to soil is quickly changed to an insoluble, retained form, it does not matter which form of P is used as fertiliser (despite what the salesman says); the cheapest is therefore the best.
- Rock phosphate is not a soluble form of phosphorus. On acid soils the best quality rock phosphate is approximately half as good as a soluble fertilizer on a percent P basis. Poorer quality rock phosphate is of less value as fertiliser.
- The Olsen soil test does not measure the P in solution, which would be of little use. Instead the Olsen test measures how much insoluble P (retained P) is available to come into solution (how much sugar is in the pitcher) and is therefore a very useful diagnostic tool.

As with other nutrients, clover has a higher P requirement than grasses. When P is deficient, clover is the first thing to go and with it the foundation of our clover-based pastoral system.

CASE STUDY: ABRON FARM PERFORMANCE CONSULTANTS

A farmer recently converted his mixed cropping operation to an irrigated dairy farm. Twelve months later he sought advice from one of the Abron Farm Performance Consultants. They collected soil samples and based on these results, offered their fertiliser advice. The farmer then asked me for my opinion.

I visited the property in August 2012. I was appalled with what I found. The pastures were terrible (they were only 12 months old!). I rated them as follows:

Pasture Assessents

Block	Rating[1]	Description[1]	Implications[1]
Whole Farm	2-4	Clover content low (0-5%) and patchy; excreta patches, especially urine patches, very prominent and yellow brown colored pasture in between; clover leaves showing typical signs of K deficiency (brown margin); <50% rye even though these are new (1 yr) pastures. Rye lacking vigour	Possible P, K, S, deficiency

1) 1 = very very poor, 10 = excellent

Soil Tests

Abron took soil tests from each paddock (i.e. ALP - see earlier article in this issue of Fertiliser Review). All of this effort and cost was predictably wasted. The farm was flat and had recently been completely re-fenced and re-sown. There was no effluent block (the effluent goes out through the irrigation system to the whole farm). For these reasons the farm could be considered as a single block in terms of the underlying soil fertility. And guess what? – the APT soil samples simply reinforced this.

After removing the obvious outliers the average soil tests were as shown below.

Block	Olsen P	K	Sulphate S	Organic S	Mg	Na	pH
Whole Farm	25	5	Not determined	5	14	4	6.1
Optimal	*35-40*	*7 - 10*	*10 - 12*	*10 - 12*	*8 - 10 (25 -30)[3]*	*3 - 4*	*5.8 - 6.0*

These results indicated the whole farm was K and S and to a limited extend P deficient. Importantly these results were consistent with the symptoms that were so obvious in the pastures (the soil tests were ground-proofed). Capital P, K and S was urgently required to get this pasture back to optimal production.

The table below compares the advice offered by Abron compared with agKnowledge's advice.

Nutrient	Abron	agKnowledge	Comments
N	157 kg/ha	200 kg/ha	Required to reach production goal
P	10 kg/ha as slow release RPR	80 kg /ha	Capital input required to increase Olsen P to optimal range. RPR not an option in this situation
K	Nil	200 kg/ha	Capital essential. This is the major nutrient limiting pasture and especially clover growth

Nutrient	Abron	agKnowledge	Comments
S	48 kg/ha as soluble S	50 kg/ha as soluble S	Capital essential in a soluble form
Ca	Yes but amount unknown	Nil	Soil Ca levels above the critical range of 1
Mg	Yes but amount unknown	Nil	Soil Mg levels above the critical range of 8-10
Na	Yes but amount unknown	Nil	Is not an essential nutrient for plant growth
Humates	14 kg/ha	Nil	Of dubious value – see article in this Fertiliser Review

This summary highlights the appalling quality of Abron's advice. The most limiting nutrient on this farm is K and yet Abron recommended no K! This is bizarre given that a plant can only grow as fast as the most limiting nutrient. Some P is recommended by Abron but much less than that required AND in a slow release RPR form – not the form to use when trying to increase soil P status. We do however agree on the need for N and S. More curiously, Abron recommended Ca, Mg and Na even though the soil tests indicted these nutrient were not required. Indeed Na is not an essential plant nutrient! And they recommended Humates, which as has been discussed in this Fertiliser Review are unlikely to be effective.

My Advice

Follow this farmers lead - he decided to set aside Abron's advice after seeking some sound scientific advice.