Animal farmers spend days deciding which semen to use, but allow fertiliser companies and fertiliser commission agents, who call themselves farm consultants, to decide their biggest annual expenditure and the one that has the most effect.

The most efficient farmers, i.e., the top 25% in terms of effective farm surplus, spend about 20 to 30 cents per annum on fertiliser per kg MS produced.

Don't use fertiliser company's advice.

Evidence of correct fertilising

These were four of Robin and Louise Hodge's springers at Otorohanga in 1991. Hodges were hesitant about using my 'correct' fertiliser mix, based on a pasture mineral analysis, so did half the farm with it and half with the same cost per hectare fertiliser company's mix based on a soil test, and grazed half the herd of 270 on each. The left cow and the front cow at the back were on the fertiliser company's typical mix with too much potassium and lacking trace elements that soil tests can't measure. The right one and very back one, were on mine. Note their good coats and the right one's head height, this mainly from enough selenium which strengthens muscles.

The left cow is condition score 3.5 (see her ribs and copper deficient hair), and the right one is 4. Half a condition score is worth about $100 per cow ($27,000 per annum if all were on it.). The cows on my fertiliser mix grew bigger and filled out over just two months on it, and produced more in the next season. You can see that the sick looking cow is low in cobalt, copper, zinc and magnesium. She also has a damaged liver, shown by the jaundiced colour between the front legs, from excess toxic P and K. Others in her batch were the same. See Animal Health > Symptoms & Causes in Animals, to see how to identify these deficiency symptoms.

Both groups got Solminix in the water, which reduces the amount of pasture animals need to eat, and gives better health. Robin and Louise then used all my recommendations.

Liming for the first time in 20 years and applying correct fertilisers, improved the pastures and increased production from 85,000 MS to 109,000 ($91,000 pa extra using the 1993 payout) in four years from 270 cows on 98 ha (2.8 cows per ha).

Anyone can calculate correct fertilisers by using the free Pasture Minerals Analysis and then the spreadsheets called Lime Nutrient Planner or Fertiliser Nutrient Planner, which have instructions on how to use them in the yellow cells.

These Pukeroro cows on the right are before my consulting, and below left, 18 months later. Analysing pasture minerals, correct fertilising with trace elements, applying lime-plus and feeding Solminix soluble minerals in the drinking water, were the reasons.

In one year the pastures became more even, and were more evenly grazed, facial eczema dropped from dozens to one, and then none. Earthworm numbers increased by 400% in two years and there were no retained afterbirths and only 10

empties, compared with “many” and 24 respectively the year before. Uneven grazing is caused mainly by a lack of calcium and salt, and excess potassium, caused by soil testing and wrong advice. See Beef Profiting, for another example, and see the Testimonials for dozens more.

A Hamilton townie friend, Barry Brunton on a 20 ha lifestyle farm had no clover and had weeds galore, until he phoned me and expressed concern that his pastures weren’t right. He asked me if I could recommend a good consultant. I couldn’t, so helped him. See Beef Profiting for the full story.

Even free range poultry need to have their pastures fertilised correctly. This photo was in May 2008. Look at what the two photos of ducks are indicating through their sheen, thanks to LimeMagPlus with trace elements and no N, P or K for two years. P and K were too high. Look at the weedy uneven pasture and rough lustre-less ducks.

Lime had not been applied for decades because the fertiliser company claimed it was not needed because the pH was 6, so for year after year, for 4 decades, NPK was all

These are his ducks in May 2008 on his typical uneven weedy pasture soon after I started consulting for Barry Brunton.

Who would have thought that correct liming with trace elements based on pasture analyses would give feathers with such sheen and health to ducks below, when grazing correctly fed pastures and getting only a few handfuls of maize daily. Look at the even weed-free pasture with clover coming in the foreground two years later, after 8.5 tonnes of LimeMag and trace elements had been applied over two years.

The ducks can’t fly so didn’t go more than 50 metres from the pond and got no Feedtech minerals.

Two crossbreds have joined the group and some have gone missing.

See Beef Profiting for more on Barry Brunton’s farming successes with beef in drought years.

Land is expensive to own, so should be fed correctly, or it becomes an expensive liability. The cost of the above lime based fertilising is less than conventional fertilising and far better, with improved soil, pasture and animal health and higher farm profits, which today are important.

Calculating the correct elements and amounts to apply are easy when using the Pasture Mineral Analysis spreadsheet in Free Items and Lime Nutrient Planner spreadsheet.

Correct Fertilising

In New Zealand now the environmental bodies are expecting (almost demanding) farmers to

prepare and operate nutrient budgeting by analysing and fertilising accordingly to avoid over fertilising, especially where effluent is spread.

Nutrient inspectors expect the Overseer Nutrient Budget to be used, so be prepared for when the inspector arrives on your farm by having your GrazingInfo Pasture Mineral Analysis and Lime and Fertiliser Nutrient Planners updated and ready. Explain that these are far better than the Overseer Nutrient Budget that is based only on soil tests which have caused much of New Zealand to have an excess of costly phosphorus in soils and leaching into waterways, a main reason for all the policing now.

A pasture analysis shows what the pasture gets out of the soil, and is 99% accurate, and is what the animals are eating, which is what farmers need to know, not what a computer thinks is needed based on a soil analysis, and was proven wrong by me in 1956 and repeatedly since, by MAF's brilliant scientist K. J. McNaught, and MAF's Winchmore Irrigation Research Station. They proved that pasture analyses show the results of fertilising within months, while the Olsen P soil tests take up to three years to show what was applied. See Elements > Phosphorus for more.

Others, and even MAF and AgResearch staff, have acknowledged the above to me, but do nothing themselves. One wrote that no soils in New Zealand need calcium and that

Overseer ignores trace elements, so animal selenium and cobalt levels have suffered, and the soil's most important element - calcium, has been replaced with urea, a soil and pasture killer. See Elements > Nitrogen. Pasture mineral analyses show nitrogen levels much more accurately than soil tests can.

Herbage and tissue analysing was first done in 1920 and was used by New Zealand's progressive fruit growers. NZ has been a big fruit exporter for ages.

In the late 1950s New Zealand brilliant agricultural scientist Dr Ken J McNaught compared the accuracy of pasture herbage testing for minerals with soil analyses, and wrote that measuring minerals in pastures is far more accurate and reliable than in soils.

Comparative figures of pasture and soils from Winchmore Irrigation Research in the South Island and many other comparisons confirm this, as do mine when consulting for 360 farmers since 1960, in many countries including USA.

During the 2008 drought the Minister of Agriculture, David Carter visited a dry, brown over stocked farm near Raglan. It was completely out of pasture. The next correctly stocked farm, a GrazingInfo client, was green and growing. He had limed his farm with LimeMagPlus and fed Solminix so his cows ate less and did better.

The drought affected herd was not far from drying off. The problem was mainly over-stocking at 3.8 cows per hectare. Our client emailed us, "At the same time our pastures and cows were still going strong."

Drilling

This is three times dearer than broadcasting. I never have and would would drill. It is unnatural and disastrous because fertiliser is best mixed with the soil, or spread on it to go in with rain, but not concentrated in strips near the surface.

Maize growers who drill DAP next to maize plants (side dress) in a dry year get half the yield (15 tonnes of silage dry matter per hectare) of those who broadcast and chisel plough it in, encouraging deep rooting, and get 30 tonnes per hectare. See photos in Forage Crops > Maize/Corn on page two.

Drilling fertiliser could be the reason for the poor kale crops in Southland, from pasture, and the success of the next crop after cultivating, which would mix the unused drilled fertiliser in, so make it more accessible. Plants can't absorb all the concentrated fertiliser applied by drilling.

Organic farmers

Print the appropriate parts of the above for your inspector. Most know nothing about LimeMagPlus which increase pasture growth by up to 150% in less than a year.

Glance through Elements > Minerals > Calcium and Phosphorus to be up to date with the latest information.

Pasture analyses should be done every spring and autumn, about two weeks before fertiliser or LimeMagPlus is to be applied.

Precedents imply that the New Zealand Overseer Nutrient Budget does not apply to Organic farmers, because they use inspectors who limit amounts of fertilisers.

The Pasture Analysis Planner and Lime and Fertiliser Phosphate Based Planners use information that avoids excesses, so are more accurate that any other system

See the Spreadsheet called Fertiliser Mixing Compatibility to avoid disasters of mixing incompatible fertilisers which can become difficult, or even impossible to spread.

Fertiliser Use in NZ in tonnes

Year	Urea	Lime
1981	17,000	1,400,000
2006	400,000	1,400,000
Potash fertilisers		
2002		359,676
2006		93,259

The above are the figures from www.maf.govt.nz/statistics/fertiliser/index.htm if they haven't changed the address! The increase in the use of Urea is frightening and combined with no increase in agricultural lime it is a disaster, and are reasons for the decrease in clover content, ryegrass pulling and lower overall soil fertility. Clover Root weevil has been blamed, but on correctly farmed farms there is little decrease in clovers. Black Beetle also gets blamed, but when I've asked subscribers to count them, some make excuses for not finding any, such as gone deep, which is tripe, because they can't dig into the typical aluminium poisoned soils craving LimeMagPlus to fix them, and the urea wrecked hard humus deficient soils.

Many clients who applied lime last autumn because of the high price of fertiliser told me that they grew more pasture than ever.

An 84 year old retired Gordonton, Waikato farmer, Lex Riddle, applied lime only in 1987 when farmers were struggling under Rogernomics 24% interest rates, and grew more pasture than ever, and more than his neighbours, and without bloat. One in the area was a high stocking-rate farmer who followed the department of agriculture, applied no lime and had bad bloat, and died young from stress.

Park trials 0904

The four brown circles are markers one metre apart, sprayed with the organic salt and vinegar spray described in Pastures > Weeds Part 1.

Left of the left markers got one tonne per ha equivalent of reactive phosphate fertiliser, S, K, Na with trace elements, which is the amount needed as a capital dressing on starved soils. (NZ$800 per tonne.)

After five months, there is still no response at all from it, in fact it was slightly negative, showing what is happening on thousands of farms around the country, and overseas. Lime is essential first. I've said this a thousand times.

All the trial applications, and the surrounding area were watered with a hose each time anything was applied.

The left half within the markers got 3,000 kg of lime per ha (NZ$180 per ha), and then the same fertiliser two months later. It is the best area with clover (it will be the original New Zealand White clover) germinating and doing well, perennial ryegrass (25 years old) and Yarrow also doing well.

The right half within the markers got lime only which got rid of the Pennyroyal. Look at the Pennyroyal to the right. That is how it all was.

Earthworms have become active under the limed area and have moved some of the lime closer to the camera (outside the square on the bottom left), so the clover is doing better there.

Twitch doesn't grow better with lime. Yarrow does, as you'll see in the attached photo of the trial in the adjacent park which would not have had lime or fertiliser for at least 25 years.

Superphosphate type fertilisers are applied once or twice a year, not for the P, but for the water soluble S which leaches. If elemental S is added, phosphates can be applied less often. If other elements are needed then more regular applications would be needed.

The elements in fertilisers are recorded as N, P, K, S. For example 15% potassic super is 0-7-8-9. Pasture in this eBook refers to typical New Zealand pastures that consist of approximately 75% perennial ryegrass and 25% white clover. A few other grasses are normal in NZ pastures as are some weeds such as dandelions, docks, etc., but the levels quoted are from sampling only perennial

ryegrasses and clovers.

One should not expect a fertiliser response from plants that are not growing because of cold, water logging, drought or heat. Soil biological activity stops at about 5 degrees C so even N applications are not likely to achieve extra pasture growth.

For many reasons, farmers don't apply enough fertiliser. One reason is in New Zealand is that the old 6 cwt/acre was translated to 600 kg/ha, whereas 6 cwt is 753 kg/ha, which is 153 kg (25%) more than 600 kg/ha.

High producers Hodges on Otorohanga hills doing 1,050 kg MS/ha applied 1509 kg/ha pa = 180 kg P/ha pa.

John Wright at Walton doing 1,260 kg ms/ha applies 1,257 kg/ha pa = 150 kg P/ha pa.

Many Taranaki farmers apply 1,509 kg/ha pa = 180 kg P/ha pa.

Top Waikato farmers apply 1,257 kg/ha pa = 150 kg P/ha pa.

Victorians (Australia) many apply 2 kg of fertiliser/kg of mf = 120 kg P/ha pa.

1984 MAF recommendations were 20 kg P/ha for 500 kg/ha mf (875 kg ms/ha), now 48 kg of P.

MAF said 11 kg P/ha required to raise Olsen P by 1 unit for Ash soils ie 125 kg/ha of superphosphate extra.

Example, to raise Olsen P 10 units (from 20 to 30) requires 1,250 kg/ha of super, plus maintenance.

MAF 1993 booklet suggests apply 0.0487 kg P/kg of ms/ha, and 0.6 to 0.8 kg/ha of 20% potassic super/ha for every kg/ha of ms. 1,050 x 0.8 = 840 kg.

NZ Dairy Group figures showed that the average spent in 1995 was $250/ha = about 140 kg P/ha. Top producers spend 50% more than low producers less.

1992 Ruakura #2 Dairy spring production was down 19% and they didn't know why! I suggested low lime and P. In 1993 they applied lime and about doubled their annual P rate up to about 100 kg DM/ha.

Peat farmers cannot hope to make a profit with less lime and fertiliser than successful mineral soil farmers are using.

Ian McDonald, Patetonga, wrote in 2001.

Our farm at Patetonga is all peat 5 to 6 metres deep. Vaughan Jones became our farm advisor in 1991. I was most interested in his 'complete picture approach' with fertiliser recommendations based on pasture analysis to give better, animal health, per cow performance and farm profit. He takes pasture samples each autumn and from the analyses he makes fertiliser recommendations, which we apply each autumn. His recommendations are based around lime, reactive phosphate and trace-elements using slow release products where available.

It has been interesting to see the improving levels of the various elements over the ten years. Our animal health has improved greatly (with the aid of Solminix, Mag C, Zinc Sulphate and Selenium added in the water). We now only have to treat two or three mild cases of Milk fever or grass stagger out of 360 cows. Cow fertility has improved so we now don't induce and don't use any CIDR's.

Profitability has improved greatly, with lower vet bills, better cow fertility, and per cow performance (380 kg MS/cow and 1,050 kg MS/ha). Soil condition has improved as well, with greater numbers of worms. Dry knobs, which are common on peat farms, have disappeared. The soil is softer and more friable, which allows better rain penetration in the autumn.

[In 2004 they calved 600 cows and only one had milk fever. They now milk 800.]

Which Fertiliser

Confusion about fertilisers is high and not surprising. Advertisements and scientist statements conflict and soil types vary so successes on one type may not apply on another.

Sometimes capital applications are required to bring fertility levels up to what is required for the type of farming. This can be when changing from sheep to dairy cows or from run out pastures on a newly acquired farm.

Some have written that superphosphate, DAP or other water soluble fertilisers are the only way to do it. This is incorrect. Trials many years ago showed that the P in water soluble fertiliser becomes fixed within a month or so depending on the soil type, so this makes them no different ffom a good RP.

Many incorrect statements are still made about RPs. For instance some say that it is not available for four to six years, when they mean "not all available" until then. Ask them how long it takes to use

up all the P in Superphosphate? If they answer, within a year, then ask them what makes the Olsen P figure increase over several years and what causes P fixation?

The availability of RP is dependent on moisture, acidity and earthworms which bury it. When cultivated into acid soils like peats, pumices and many other New Zealand soils, it can produce much better results than Superphosphate even with crops, especially on a dollar for dollar basis, because RPs are cheaper with 50% more phosphorus than Single Superphosphate, but finely ground elemental sulphur usually has to be added. Being acid, it helps make the RP become available.

How much fertiliser

Lime is the first essential, then after deciding the makeup of the fertilizer needed to correct critical deficiencies the decision on how much of the main growth elements to apply depends on -

- How severe the deficiency symptoms above are. What the pasture analysis shows. Forget soil analyses.
- Efficiency of pasture utilisation. If all pasture is not being used there is no point in growing more. Doing so could actually lower overall animal production.
- Rainfall expected to wash it in. Fertilizer without moisture doesn't work.
- Likely response from the pasture or crop being grown.
- Financial returns achievable from the product to be produced.
- Amount of dry matter (pasture or crop) required over the fertilizer release period.
- Number of livestock aimed for.
- The requirement for a capital dressing of some elements such as phosphorus.
- Soil type. Sandy soils leach so smaller more frequent applications may be necessary until the soil organic matter builds up.
- Cost of regrassing pastures which run out through lack of fertilizer.
- Cost of land. Expensive land justifies more fertilizer. If land is very cheap it may be better to buy more land rather than fertilize the existing land, unless pasture and/or animal health are suffering from deficiencies.
- Income tax situation. It may pay to fertilize before the end of the financial year and/or to increase the amount to even out taxation between years to avoid paying at a high rate in one year.

Pasture and milk production per hectare have doubled in the last 40 years which means more minerals are being removed, so have to be replaced.

Pasture analyses that I've done over the years in high producing areas such as eastern Waikato show that some major and minor mineral levels are decreasing when they should be increasing.

Fertiliser starvation

Farmers world-wide usually fertilise pastures at much lower ratess than crops, so pasture condition and production frequently reflect this and some then rubbish pastures and talk about how much more crops yield per hectare.

Fertiliser application rates per hectare in New Zealand are sometimes much lower than they were in the 1950's and 60's pre metrics. Many top Waikato dairy farmers in the 50's applied about 5 cwt per acre twice a year, and an extra 3 cwt on the silage and hay paddocks. This totalled 13 cwt per acre on harvested paddocks, which is 1,456 pounds per acre or 1,635 kg per hectare per annum.

Some applied more, but now there are very few who apply even 1,000 kg per hectare per annum. Some changed from 5 cwt (560 lb)/a to 500 kg/ha, so reducing the amount by 128 kg/ha or 20%.

ALSO, K application rates were increased, so less of the fertiliser was P and Ca which is in the P. Some farmers have lost clovers because of the excessive amounts of K in 30% potassic super. I have got clients whose clovers decreased to stop applying K and apply 40 kg/ha of agricultural salt twice a year and then annually and clovers have returned on their own. Quite often I have had to get them to do just one paddock because they were so indoctrinated that 30% was the only way to go.

K was promoted a lot in the early 50s and 15% potassic super certainly improved clover and pasture growth dramatically, so some went to 30% which they considered as 'high octane'. MAF and Ruakura encouraged them, but not to increase the total amount of fertiliser applied. Ruakura has always applied less P than the top farmers and boasted their high production per hectare, but their figures were based on a very low effective area with even water troughs out and with small herds walking short

distances to luxury milking and a vet on hand. Their pastures have never looked as good as those of the best farmers and they have undersown more than half their paddocks in some autumns.

Analyses	**P**	**K**	**S**	**Ca**	**Co2**
Single Superphosphate	8.5	0	11	21	
15% Potassic Super	7	8	9	18	
30% Potassic Super	6	15	8	15	

As can be seen, in 30% Potassic Super, P rates drop by 33% and Ca and S by nearly as much.

In the 60s the top Waikato dairy farmers were producing about 300 pounds of milk fat per acre, which is 337 kg per hectare, or in today's terms, 583 kg MS/ha. Most farms in the Waikato now produce about 900 kg/ha MS/ha while some produce double that. The elements being removed have to be replaced.

Research into low production in Northland and Bay of Plenty showed that their phosphorus levels were much too low because they had followed the MAF recommendations. No wonder we hear frequent complaints about a lack of clover, weeds increasing and grass not growing.

To continue producing milk at the levels being attained by the top producing farms, capital dressings of 1,500 kg/ha in two dressings if water soluble Superphosphate or DAP, and regular applications of >1,000 kg/ha of essential elements are necessary.

Low farm product prices in the 90s caused a decrease in fertiliser application, but these should have been corrected during the subsequent higher payouts. Luckily, cow quality, clover varieties and overall management have improved considerably, so production per hectare has increased.

With the higher stocking rates farmers found that it paid to use N prior to winter and prior to summer, and then some applied it all year, especially after Clover Root Weevil just about eliminated clovers, especially in low fertility and over-grazed areas where I've seen the lack of white clover aggravated by it being pulled out by the runners, while clovers thrived just through the fence.

The Clover Root Weevil egg laying is random on pasture and soil and the hatch rate is very low. It relies on the eggs falling or being washed to the ground, so the hatch rate in very short grass is much higher than in long grass.

The decrease in clover has been severely aggravated by lower Ca and Mo levels in some soils and lower Co levels caused by lower organic matter is soils following the increase in artificial N use.

Where feed (silage, hay, grain) is being bought in less fertiliser is necessary, as long as the animal manure is spread onto pastures soon after it is dropped, not after it has been stored in heaps as on some North American farms and leached losing N and S. Even when stored in tanks N and S can be reduced by gassing off.

When animal manure from parlors is spread by travelling irrigator soon after it is dropped, losses are the least and pasture response the best.

In all cases pasture should be analysed and whatever is lacking, should be applied.

Farmers who buy lots of grain and other feed are bringing fertility onto their farms so will not need as much fertiliser to maintain fertility, but will still need to test pasture tissue and apply the required elements.

A tonne of pasture DM contains 45 kg of N, xxxxxxxxxxx etc. When removed from harvested paddocks it needs to be replaced by feeding it back there or extra fertiliser.

There are two main reasons for fertilising - to grow a maximum of healthy profitable pasture and to have healthy highly productive profitable animals. Medical authorities and veterinarians have said and written that many human and animal health problems are caused by mineral deficiencies or imbalances.

Xxxxxxxxxx East Texas reported xxxxxxxxxxxx

The benefits of a correct balance of elements in pasture soils can't be comprehended unless experienced. Comments from users include: the pasture became thicker and healthier within three months - even the fertilizer spreader driver asked what I'd done; grazing became more even; clover leaves grew larger than I'd ever seen; and that pastures grew better and weeds decreased.

The good, or bad factor, depending on your outlook and situation, which has been repeated dozens

of times, is that wild life numbers increase on farms with balanced soils and good pastures. The only way I know of to handle this is to encourage neighbours to also balance their soils and pastures for the good of all concerned, including their inheritors.

Reports of production increase are numerous, and even if this doesn't occur or is not noticed, users become delighted about the improved animal health and reduced vet bills.

Pasture tissue analyses are far easier to read than soil analyses because pasture ones are more consistent, but you should allow for the soil type, the season and stage of growth. As plants mature, the percentage of most trace elements in the whole plant tends to decrease, but silicon increases.

Intensive grassland production even under grazing, lowers the soil's reserves of trace elements. This happens more quickly in soils which were initially a little low.

Underfeeding of animals can cause many of the problems we sometimes blame on deficiencies or infections. Animals stocked at low rates on good pasture are highly unlikely to suffer deficiencies, unless there is a serious deficiency of items such as cobalt or copper, because they can select, and eat plenty. High stocking rates on the same area can cause problems, including parasites which can aggravate a deficiency.

Insufficient feed, and/or loss of appetite through a mineral or vitamin deficiency can affect the poor doers because the stronger faster eaters get more than their share at the expense of the suffering. Smaller animals and the slow eaters (slow by nature, with teeth problems, undershot or overshot jaws, etc.) in an under-fed mob can suffer deficiencies which can then further aggravate the problem.

In nature this is known as the survival of the fittest, but in farming it is a cost. Some blowhards boast that “They'll have to look after themselves”, and the animals do their best, but at the expense of the owner.

Fast growing young stock are more likely to suffer deficiencies, especially if under-fed or made to compete with older animals.

Under-feeding and parasite infestation can cause deficiencies, and conversely when feeds are balanced animals can cope with and even throw off most parasites much better.

There are synergistic and antagonistic elements which can affect vitamins and minerals, so avoid excesses of anything and read instructions. It is very common for the symptoms of deficiencies and excesses to be identical, however pasture analysing solves this. Levels of the other elements and that of the pH help solve the question.

Some animals will suffer deficiencies before others, so watch for deficiencies in the poor performers and correct them before they affect too many.

Few would question that the best source of balanced minerals is from the soil into the feed, however with pastures it is impossible to supply all the minerals necessary for a fast growing or high producing animal. The next best is by SMM. Rumen boluses are also a good way of supplementing minerals, although with these a top veterinary company warned about one type of bolus affecting another, so seek vet and supplier advice before using any together, or even in sequence. Sometimes as long as six weeks apart is necessary to avoid complications.

Grasses alone have more difficulty in suppyling all an animal's mineral requirements, and tropical grasses have very little calcium, sodium, etc., and fertilising with these elements won't solve the deficiencies. Temperate area grasses are better, but including legumes is important, however, even then minerals should still be supplemented to animals on all pastures.

Some question the necessity of fertilizing grazed pastures at all and some question the necessity of feeding trace elements if a variety of pasture species is provided. The reasons are because -

• No soil I know of is complete - and I've visited many areas world-wide and seen the results of close to a thousand pasture tissue samples from many countries.

• Depletion of some elements occurs after farming and selling food off soils for a few decades.

• Pasture provides the cheapest feed there is. Fertilising with all the necessary elements to grow more pasture is the next cheapest way of growing more feed to carry more stock.

At this point it may be worth describing the word “farming”. It is not “mining”, but can be, if food is sold off the farm and not much put back, or if food is sold off and only N or only the main elements are returned.

In my opinion, farming is improving the farm, not just sustaining it. at the same time as producing food and/or products, and making a profit.

If profit is required, rather than just plenty of pasture or crops of low quality from applying only nitrogen, phosphorus and potassium, then a balance of all elements is important. For example if cobalt is lacking, ruminants will lose appetite within a short period and even die, while horses will thrive without it. Zinc and selenium are also important at levels higher than some may recommend for straight out dietary requirements. The requirement of animals for various elements varies with the seasons and period of lactation. Perhaps most importantly, the optimum level of some elements depends on the levels of some others. In this respect it is better to have all low, rather than some high. Balance is the critical factor.

Even major elements must be in balance. AgResearch scientist Dr Alan Sinclair says there is no point putting on phosphate, if pasture growth is limited by a lack of sulphur. "For high clover yields, the right combination of sulphur and phosphorus is essential, so farmers should know the importance of choosing a fertiliser that will give well-balanced nutrition for their own particular site. Plant analysis of clover can give a good indication of a balanced fertiliser policy."

When excesses of some elements are fed for a period, animal absorption declines and the animal becomes less efficient, passing out more through dung and/or urine. This can put a load on the system so should be avoided. When absorption becomes less efficient from excesses the body can later suffer deficiencies, if even normal amounts are fed, until absorption efficiency improves again.

Care must be exercised when moving animals from a farm feeding mineral supplements to one where none is fed. Obviously it would be best to continue feeding the required minerals, but if not possible reduce the minerals gradually before moving them to reduce the ill effects which can be quite severe if the move is also to inferior pastures.

Other points worth noting are -

• Some minerals such as zinc and selenium are anti-oxidants so depress free radicals (polluters).

• The correct balance of minerals in a soil is the more important than having sufficient of any one element.

• When soils become a little drier than usual, plants which suffer from toxic levels of some elements start to wilt, although soil moisture may still appear to be adequate.

• As plants mature, the percentage of trace elements of the whole plant tends to decline.

• Mature grasses vary in their element content between leaves and stem.

• Different levels of selenium cause different problems on different farms, and amongst different breeds of cattle.

• Some deficiencies occur on some properties, but not on neighbouring ones, sometimes because of different waters such as high iron ones lowering copper absorption.

• While some animals can suffer deficiencies severely others are not affected.

• Not enough thought and time are put into fertilising programmes, and too many are short on the total requirements, for example calcium, as in agricultural lime, is just as important on most soils as phosphorus, and calcium is not taken up by plants if boron is too low.

• MAF have at last acknowledged that boron is an essential plant food.

• Others equally as important are cobalt, molybdenum and salt.

• Most people associate cobalt's importance with animal health, but it is also essential for clover nodulation.

• Molybdenum increases clover growth and helps buffer nitrate toxicity. It should not be applied unless very, very low, because once on is hard to balance. In most cases the application of lime increases it sufficiently.

• Salt supplies chloride, makes pastures softer and more palatable, and reduces potassium ill effects on animals and it's leaching from soils.

Types of Fertiliser

Where SMM has been used as lick and been spilt, the pasture has grown considerably better. SMM contains mainly salt, then magnesium, zinc, copper, cobalt, iodine, selenium and other many other elements found in sea derived products, showing that more than calcium, phosphorus and potash grow grass.

When deciding on which fertiliser to use, pasture test, then buy only the elements required, not shotgun brews with minute amounts of almost everything.

If you need phosphorus, compare the applied cost of phosphorus per kilogram. Superphosphate is

usually 30% dearer per pound of P than a good RPR. If sulphur is needed this will change the figure, because single Super already has S, but in a water soluble leaching form. Elemental S, which doesn't leach, can be added to RPR.

Saga

A saga over fertilisers started when the cost of conventional NPK fertilisers in New Zealand went through the roof to over $200 a tonne from about $35/tonne in the 1970's (over $500 in 2008).

The price increase coincided with decreased farm returns, so farmers who had previously been quite happy to use the conventional superphosphate and potash, as recommended by almost all advisers, started looking at the alternatives, like organics and liquid fertilisers.

When New Zealand basic slag became available, many farmers, remembering the enthusiasm some had for the old imported Belgian basic slag, tried the local product, but with most unfortunate results of poisoned animals in some cases.

MAF openly criticised everything except superphosphate and muriate of potash and recently some reactive phosphates, however some farmers were getting equal, and in some cases better, results with reactive phosphates at a lower cost.

This pleased the users and should have aroused MAF, but no such luck. Had they been observant and reactive they might have investigated all the possible reasons for the claims being made.

Up until recently most advisers knew little about fertiliser recommendations except to go by the erratic results of soil tests. To most having been through agricultural universities everything else was "muck and magic", a typical statement from scientifically (but not practically) trained academics. Most MAF staff criticised the growing system in private enterprise of analysing pastures to decide which elements were short - and which were in abundance, an equally important aspect.

Had the guardians of the fertiliser industry had open minds - as all scientists surely should have - they might have come up with answers like those listed below, which would have had much more credibility than the statements they did make, which in general could be summed up as - "Everything except the recognised NPK (nitrogen, phosphate and potash) is a waste of money".

Reasons why liquid products have had some short-lived successes include-

Liquid fertilisers are not

Applying deficient items to the leaves instead of to the soil is very expensive labour, tractor and product wise and can be risky. Also earthworms need the elements that animals need. When water troughs getting Solminix run over, the earthworms move into the wet area. When those without added elements run over the earthworms move away from the wet area.

I’ve done trials in my compost and found that earthworms move to where I spread the fertiliser mix I use in the garden and to where I spread Solminix.

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1. Excessive amounts of solid fertilisers have been applied by farmers to join in the rat race for higher production per hectare.

2. Many farms were over-fertilised with phosphate and potash during the period of comparatively low fertiliser costs, and comparatively high receipts for farm products. A MAF survey of 300 farms in the confirmed that 70% of farmers had applied too much phosphate and 40% too much potash.

3. Many farmers were told that when they have a soil with a high phosphate fixation, they had to increase the amount of phosphate applied, and keep applying these high rates annually. After applying adequate lime and a capital application of P, regular applications help to work with fixation, however, fixation is not all bad, it doesn’t mean that P is leached or lost.

4. Most New Zealand pastures will respond to nitrogen at most times of the year. So the application of liquids, most of which have some nitrogen, give a response, which pleases the user and the soil, because it helps the grasses to use up some of the surplus P and K.

5. However, the amount of N these liquids contain is nowhere near enough to give the N boost that they do. They are usually fish and/or seaweed based which have to be preserved to stop them going bad, so are preserved with formalin or an equivalent. Manufacturers now claim that they don't use formalin. Any preservative when applied to soils will kill some soil microbes which when dead release nitrogen giving a greening up of pasture. Repeated application of the liquid products without solid fertilisers gradually depletes the soil microbes and essential elements.

6. Most liquids are based on fish and seaweed, that could contain micro nutrients and trace elements we don't know about, and that soils, soil organisms, insects (dung beetles), earthworms and grazing animals may appreciate.

7. Many of our pasture soils have potassium levels much higher than the optimum for animal health, so the lack of potassium in liquids can be a blessing.

8. High potassium in soils suppresses the uptake of magnesium, sodium and some other elements so applying a liquid instead of those with potassium, improves the balance, so magnesium and sodium levels in pastures increase.

9. Many farmers believe that potash is magic, and is like octane in petrol i.e., low octane is not as good as high octane, so they think that way with fertilisers and think that low octane is 15% potash super, and high octane is 30%!

10. One fish and seaweed product agent had the brownest and poorest farm in the area and after about five years of using his company's products went bankrupt and the liquid fertiliser? company followed.

Farmers should do their own equal cost pasture tests and trials.

A MAF statement that "The farmer does not have the inclination, resources or training to conduct proper field trials..." is far from right. Many farmers certainly do have the inclination, resources and ability to conduct fertiliser trials on their farms, and in many cases are doing so, using dry matter measuring with PastureGauges or just by counting the grazing days and/or bales of hay produced from controls and the trials, and entering the information into

The results have seen sales of some fertilisers such as reactive phosphate are increasing.

Most liquid so-called fertiliser manufacturers claim that their products contain seven important trace elements. However, they don't state that the total value of most is less than 0.14 cents per tonne (1,000 litres of most costing about $3,000), which makes the products valueless.

Recently, to match these claims, one solid fertiliser manufacturer promoted that their super phosphate contains the same elements.

The New Zealand agricultural industry and all countries without one, urgently need a consumer service.

Effects of Fast & Slow Release Fertilizers

Roots only grow as far as needed to get what they require. I've seen clover roots go down and grow horizontally along the bottom of a plough furrow after lime had been mouldboard ploughed in. At that point the roots were loaded with nodules, but had none before then. They didn't grow beyond the lime area.

The result is that if ample fast release fertilizer is spread on a pasture the roots may develop on the surface. The result of this can be a sudden decrease in pasture yield when dry weather comes. With this shallow rooting, moisture in the areas is used up by the plants faster than if they were deep rooted, aggravating the dry weather effects. Poor drainage has similar effects because roots don't go down into the water-logged soil.

Slow release fertilizers such as good reactive phosphates, lime and elemental suplhurs cause deeper rooting of plants because earthworms take them down so encourage deeper rooting. On John Wrght's dairy farm after a few years of using my mixes of the best reactive phospate and other required elements determined by pasture sampling, we found white clover nodules at a depth of 30 cm (1 foot).

Basic Slags

Basic slag is an impurity by-product of steel industries and in early days was a common form of phosphorus (P) fertiliser. The analyses varied depending on the steel raw material, the lime and the procedures used.

Some basic slags have toxic amounts of fluoride and other elements. Analyses vary from between 0.1 to 45 P, 30 and 50% burnt lime (CaO) or slaked lime (Ca(OH)2), 0.4 and 5% magnesium, 0 and 7% sulphur, 0 and 0.2% boron, 0 to 1% fluoride and many other trace elements.

Some, if not well ground to under 2 mm diameter and spread on pasture can poison animals and kill them fairly quickly. Some, if spread on damp pasture will stick and be hard to wash off even with heavy rain, so be adversely affect animals.

Some claims are made about some basic slags which are not strictly accurate. It is better to anaylse pasture or crop tissue and apply the deficient elements at the required level, rather than applying a "shot gun" product where some elements may not be necessary, or could even be in excess. Generally I would suggest not using slag as a fertiliser where animals can graze or where human or animal foods are grown.

Mineral deficient animals can lick the soil where it has been applied and suffer toxicities or poisoning. Where it is available at attractive prices based on the amount of element required and without unwanted toxic substances, it could be considered if to be cultivated in to the soil.

No basic slag or fertiliser should be left where any animal (or child) can eat it even after being applied. 150 died in New Zealand in one year.

If spreading it, or any fertiliser for that matter avoid getting it into water troughs and waterways. If this is not possible, use covers over the troughs to avoid possible poisoning and causing algae growth in troughs.

Other industrial wastes can contain toxic cadmium, lead, arsenic and dioxins, so should not be applied to soils unless an independent analysis has been obtained showing levels are safe. Many normal fertilisers have low levels of these items, so some can be present.

Slags have killed hundreds of animals in New Zealand.

DAP & MAP

Di Ammonium Phosphate (18-20-0-2) and Mono Ammonium Phosphate (11-20-0-0) are water soluble fertilisers developed as a starter fertilisers for crop growing, not for pasture. Even with crops like maize, a base fertiliser is also used to continue feeding the plant after the DAP has been used or leached.

Being water soluble it is all available to the plant and to leaching. Pasture, being a greedy feeder takes up more than is ideal for animal health.

When used on pasture they have to be applied at frequent intervals of up to four times a year, and even then pasture growth will stop in summer when the shallow roots associated with water soluble fertilisers run out of moisture.

See Fertilisers>Nitrogen for details on the effects of DAP and MAP on animals.

If after buying a farm which is low in N and P, and there is little pasture, then applying DAP once is acceptable, because it is better to have unpalatable pasture than none. Profit from farming is long term, so at the same time apply about 1,000 kg/ha of a good RPR or Superphosphate if pH is above 6.5 and rainfall below 800 mm. Always also add other elements to make a balanced mix, determined from a pasture analysis.

Profiting from pasture depends on cows consuming plenty, which means as well as going plenty of pasture, it has to be palatable.

USA dairy farmers try to get their cows to consume up to 27 kg DM/day, but we seldom get 17 kg intakes. Some of their high intake figures are, however, because they have bigger cows and also feed meal.

We read and hear about high production from some farmers using large quantities of super, DAP, MAP, urea, etc., but seldom hear of the failures. One in the Eastern Waikato who was written up last year had six cows die simply because cobalt was too low, an increasing problem in the area, especially when boosting fertilisers are used. Other cows were adversely affected with low vitamin B12 and loss of appetite.

There is no excuse for this when 15 elements, including cobalt, are easily detected in a pasture test costing about $100. Young stock in particular need cobalt which is easily added to fertilisers.

But even crops can do well with RPR and a 100 kg per hectare of DAP all chisel ploughed in. The best looking maize crops in the Waikato for three years had Sechura as the base fertiliser.

Application

When spreading fertilizers make every effort to avoid waste and to get an even spread. Don't fertilize near gateways, around water troughs, under hedges and similar areas which are already over fertilized, because doing so is a waste. Fertility is lower under fences because animals can't drop manure there, especially under and near electric fences, because animals soon learn to avoid rasing their tails near one, in case the wind blows it into an electrified wire, so you should keep close to fences when spreading fertilisers. Ensure that none gets into water troughs because it will increase the algae growth.

Don't spread onto dewey or moist pasture unless it is raining or rain is due soon to wash it off the leaves. Most solid superphosphate fertilisers have fluoride which is toxic, so avoid grazing until at least 25 mm of rain have fallen.

When to apply

MAF recommendations for main fertilising with P (yes P not N) in the past have been for twice a year (autumn and spring) applications, but recently their recommendations for fertile soils have changed to once a year, at any time, but still twice a year on poorer soils.

Since the late 50s I have applied and recommended that others apply all the main fertiliser (P) in early autumn despite the then MAF figures showing more total growth was achieved with twice a year applications. They didn't allow for their own figures which showed that twice a year grew less in winter (when needed) and more in spring (when not needed). Unfortunately, all these recommendations come from research figures measured on maximum pasture growth per annum, not from maximum animal profit, and they didn't consider the practical aspects like animal nutrition and the aim of levelling the pasture growth curve.

The profitability comparisons that I've done on many soil types (fertile and poor) many times since 1958, have always shown that maximum dollar return is achieved from applying all fertiliser in late summer/early autumn. The exception to this is new grass, which usually needs at least 100 kg/ha of P which is about a tonne of reactive phosphate and other elements as a capital dressing at sowing (followed by regular nitrogen), and a normal rate of P and other necessary elements in early spring, again with N, followed by annual dressings each autumn.

The recommendation to fertilise in early autumn was based on the requirement to stimulate growth prior to and during the slowest growth period (winter), and because the profit made out of most animal farming is related to the number of stock wintered. Buying animals in spring and selling them before winter will make no profit.

All the figures I've seen and all the trials I've done show that autumn fertilising increases winter and early spring growth, which used to be the two critical periods for setting the season's animal carrying capacity and production.

Backing this, researcher W.M.H. Saunders who is one of NZ's most practical and useful researchers, found that, "In spring the pasture made effective use of phosphorus irrespective of when it had been applied, but in autumn the pasture responded much more strongly to applied fertiliser.

"Immediate response to P fertiliser in spring (fast growth period) was only about 10% (against the spring fast growth), but in autumn and summer (slow growth period) it was 35 to 45%. This pattern repeated itself in trials each year', he pointed out.

So because extra growth during lean periods is more valuable than during spring, application should be timed to avoid more spring growth. On top of this, excess spring growth can be a cost if it has to be harvested for lean period feeding. It may have to be topped in spring to keep the pasture palatable, to avoid animal production dropping and pasture deterioration. In snow covered areas where lots of

winter feed is necessary and has to be harvested from pasture, spring applications including N may be necessary especially if clovers are not present.

Leanest Period

With improved soil fertility and increased pasture growth in winter in temperate areas, better winter growing ryegrasses and clovers, and the use of N, winter pasture growth has increased. Also cows are dry then so are consuming only about 8 to 10 kg DM/day depending on size.

In late summer animals are needing more to produce milk or to put on meat to finish beef cattle before winter, so the late summer and early autumn periods have now become the critical period in many areas, when, without moisture nothing grows.

Applying fertiliser to grow more feed immediately before and during the dry summers can be beneficial. There are many other reasons for applying fertiliser between late October and late November, before or after making silage or hay. These include -

• A wet winter and spring could have leached much of the autumn fertiliser, especially the sulphate from Single Superphosphate used by so many in NZ, but no farmer in USA where it is not even made, and a mild winter and spring, growing more pasture, will have used up more of the fertiliser, leaving less to grow pasture in late summer.

• Fertilising a few months before lean periods is obviously an advantage so fertilising in early summer and getting it washed in will grow more feed in late summer and autumn. Any surplus can be carried into winter by lengthening the rotation.

• Grass staggers is greater when ryegrasses become dry and stemmy. Higher fertility in summer produces more leaf.

• Facial eczema is worse when pastures are short and grazed close. Extra fertiliser before summer can help keep pastures greener and growing more.

• With the trend to more reactive phosphate (RP) fertilising, applying it in late spring or early summer when moisture is usually adequate, allows time for it to become acidified (available) in the soil.

• In autumn when short of pasture and rain, getting fertiliser washed in before grazing can be difficult. Every autumn some animals are poisoned by fluorine in P fertilisers, even when grazed weeks after application, if less than 25 mm (1 inch) of rain has fallen.

• Fertiliser should not be applied to soils which have cracks, because the fertiliser can be washed down them and lost. Waiting for sufficient autumn rain to close the summer cracks can delay application into winter.

• There is less fertiliser runoff (wash) from early summer dense pasture than from dry cracked autumn soils after a dry hot summer.

• Heavy autumn and early winter rains on bare overgrazed pasture can wash fertilisers away and/or leach fertilisers into lower soil levels and waterways.

• Rainfall in late spring and early summer is usually more regular than in late summer and early autumn.

• Some properties get very wet in late autumn once rains fall on bare pastures, making spreading difficult, which can then delay application to the detriment of production, or make a mess of paddocks.

• Autumn can be busy with renovating and regrassing paddocks.

• The high demand for fertilisers in autumn can mean delays. Fertiliser companies can run out and/or supply raw, damp, difficult to spread fertiliser. Excessive demand can even mean waiting for the next ship and paying inflated prices. Buying when others are not can sometimes achieve lower purchasing and spreading costs.

• It is easier to bunch up dry stock (all except milking dairy cows) into fewer mobs and graze them on a fast rotation in early summer than in a dry autumn.

• If autumn rains come quickly and soils get wet it can be difficult spreading fertiliser then and the closer it gets to winter the wetter it can get.

More Winter Growth

The increased use of winter ryegrasses has helped reduce winter shortages and moved the slowest growth period in most years, in most areas, from winter to the late summer/early autumn drought period. Good winter ryegrasses on reasonably fertile soils grow at 50 kg DM/day in most Waikato

winters, while perennial ryegrasses grow at about 20.

Another, and most important, aspect of this winter growing grass is its excellent response to the use of late autumn and late winter nitrogen, while the same amount of N on a perennial ryegrass pasture may not give much response. In the 1989/90 season Concord winter ryegrass outyielded perennial ryegrasses on several Waikato farms from autumn to mid February, and in 1988/89 from autumn to mid January. There are now higher yielding longer lasting winter ryegrasses.

Trials done in Europe show that animals prefer winter ryegrasses, so consume more and produce more. In Australia, from Queensland to Victoria, Concord is popular for its high yield and extended growth period and in a trial out-yielded Greenstone by 11%. The MAF theory about Argentine Stem Weevil has been disproved on so many farms as to make it of no consideration.

Analysis see page

Get new one with cow and milk figures.

Percent & value spread, of elements in effluent from cows fed 15 kg DM pasture/day

Element	Pasture %	Dung %	Urine %	kg/cow	NZ$
N	4.5% 25%	50%	0.50	$0.50	
P	0.45%	65%	0%	0.07	$0.10
K	3.0% 10%	80%	0.40	$0.32	
Ca	0.7% 75%	5%	0.08	$0.03	

Good News

The good thing is that now, with top quality reactive phosphate RPs like Sechura available, the amount of total tonnes of fertiliser necessary is less, because RPR's have 13% phosphorus, instead of the 9% in Single Superphosphate, some of which is lost through wash down slopes and into cracks, leaching and fixation (DSIR Kaikohe and Australian research).

Moreover, it is easy to add the required amount of slow release elemental sulphur to RPs, whereas Super already contains 11% which is too much sulphate sulphur. This is all water soluble, so washes and leaches, taking other elements such as potassium with it (Indian and Massey University trials).

W.M.H. Saunders said that savings to NZ farmers on some soils through using RPR with elemental sulphur, rather than Superphosphate, could add up to $50 million a year.

A major cause of K leaching in NZ is the use of Single Superphosphate with its 11% sulphur which leaches and takes K with it. Thank goodness Single Superphosphate and its mixes (15% potassic super and 30% potassic super) sales in NZ have dropped from 90% of all fertilizers to 30% and reactive phosphate sales have increased substantially. Even the 800 ha (2,000 acre) Whatawhata Hill Country Research Station has used RP since about 1995. Top farmers have since the 1980s.

Many incorrect statements are still made about RP. For instance some say that it is not available for four to six years, when they mean “not all available” until then.

The availability of RPR is dependent on its particle size, soil moisture, soil acidity and earthworms which bury it. When cultivated into acid soils like peats, pumices and many other New Zealand soils, it can produce much better results than Super, especially on a dollar for dollar basis, because RPR's are cheaper per kg of P.

The Movement of Fertiliser

A hectare of pasture with 3,000 kg DM/ha (20 cm tall) at 3% potassium (some tests at over 4% K) has 90 kg/ha of potassium or 180 kg equivalent of Muriate of Potash (50% K)/ha in the pasture, which is the equivalent of 600 kg/ha of 0-6-15-7 (30% potassic super) in the pasture. Grazing this and having most of the urine returned to the paddock is like giving it the equivalent of the potash in 480 kg/ha of 30%.

Animal and production losses of K through milk, meat, bones and in races, is only about 20% of intake, and in some soils is replaced naturally, so large regular applications of K are seldom required.

Research over seven years with no fertiliser showed that the amount of clover dropped to 11%.

Six months after applying fertiliser the clover content increase to 29%, Browntop decreased from 20 to 11% and weeds decreased from 40% to 31%.

Expenditure on fertiliser is the highest returning investment we can make.

Bringing feed on to your farm is like bringing on fertiliser, except that you don't have control of what elements you are bringing on. In most cases the result is an increase in potassium levels. However, if you are confinement feeding and not spreading the animal manure,as is the case on many dairy farms I've seen in Northern Hemisphere countries, then soil fertility can decrease, not increase. See Effluent.

Many feed their animals balanced minerals, but don't feed their soils balanced fertilisers. If they did, their animals would be healthier and not need so much in the way of mineral supplements, although the modern high producing animal can't get sufficient of some elements from modern high producing pastures, especially single species pastures.

Most cultivars have been bred of speed of growth, not for quality, and most pastures are fertilised for speed of growth. The same plants growing fast are higher in moisture and lower in most minerals. The following analyses show this.

More Land Almost Free

Would you like the equivalent of about 25% more land for $250/ha this year and then for an extra $100/ha per year thereafter? No capital outlay is needed because no more land need be bought, and no more rates, lanes, fencing, draining, etc., and the whole cost comes off income tax.

If your P (phosphorus) and calcium levels are low, and most are, the above can be achieved by growing 25% more pasture after applying the correct lime and then fertiliser at 1 tonne/ha.

Once P levels are up, future fertilising can drop back. It won't work with half rates - the dam has to be full before it can be used completely. Soil microbes use the first P applied.

Signs of needing more lime and/or balanced fertiliser include -

- Bare patches in pastures.
- o Too many flat weeds (dandelions and plantain). There will always be some.
- o Poa Annua increasing.
- o Clovers decreasing and having small leaves and fewer nodules.
- o Perennial ryegrass or other high fertility species dying out excessively in cold, dry and hot periods.
- o Dung and urine patches showing up (standing out) strongly.
- o Moss increasoing.
- o Thatch (layer of dead grass at ground level).
- o Selective grazing.

Fertilisers

Several clients have commented this spring that they've seen a response within a month of applying the Sechura mix, showing that the 1992 spring responses, which were slow, were caused by the weather, not the fertiliser.

Most are applying a tonne or more per hectare (some twice a year) while the payout is up, which is pleasing, because for years insufficient has been applied. Not much could be done about increasing fertility when the payout was about $4.

You should all do fertiliser and lime trials on your own farm. All others can do is recommend levels from experience. Research institutes use “models” which have been proved wrong many times. Do your own trials on your different soil types by applying 50% less and 100% more on different paddocks, and measure (or eye assess) the difference before and after each grazing between the extra fertilised paddock and a control. Add the totals consumed and give them to me with rates of fertiliser or lime applied. I can then work out, against the payout and land values, your optimum rates. High returns and high land values justify more fertiliser. When land is cheap, it can pay to but more land, but not if you are already losing money because of poor farming, possible through poor fertilising.

Fertilising pasture 20 years ago was a straightforward decision, because there were so few fertilisers available. Now there are a bewildering number available, with some promoted as we've never seen before, so for a farmer to decide which fertiliser to use is far from easy.

However, with today's accurate pasture analysing facilities and the knowledge of the pasture's and animals' requirements, it doesn't take long with a computer to calculate the required fertiliser and trace elements for various soils and animals.

Fertiliser is the highest annual cost for most farmers - up to $300/ha, and yet in many cases less time is spent on its planning than on deciding which semen to use, the cost of which is about $40/ha.

Most farmers understand parasite cycles, discuss their control programmes with their veterinarians, and achieve good control. However, when it comes to fertilisers, the ignorance is appalling, and worsening, mostly because of the extensive commercial promotion by the wide variety of fertiliser suppliers and researchers being sponsored by fertiliser companies.

Pasture responses from the Te Kuiti trials again show Sechura well ahead of other RPR's. Figures are based on equal amounts of P. On an equal cost basis the RPR's, which have 50% more phosphorus, would have been 30 to 40% higher, but as with most super comparisons, RPR's were disadvantaged cost wise. Super was 24%, Sechura 16%, North Carolina 12%, Quinphos 9%, Nauru 8%, Arad 6%.

I recommend again that you do your own trials, but, if you do superphosphate or DAP comparisons on paddocks which have had RPR, the results will favour the fast release fertiliser because RPR will continue to become available.

It is good that AgResearch have at last realised that more P and Ca are necessary, but their estimates are still too low.

I have written a computer programme which calculates the amount of P removed and adds up the amount of P applied over the years. Almost all have been losing fertility over the last five years. AgResearch low recommendations and the low payouts have aggravated the deficiency. The programme is available for most types of computers so can calculate yours.

Fertiliser mixing

If any of you had bulk fertiliser arrive at any time last year incompletely mixed, please tell me about it, because in New Zealand it is illegal, and it can adversely affect soils, pastures and animals. I will investigate it, but will not mention your name.

Aims

As with everything, the aims must be defined.

If the aim is solely to grow more grass at a certain time of the year, then the fertiliser will be different from a long term aim of improving overall pasture growth and animal health.

Farmers don't want maximum pasture growth, they want maximum animal profit. If maximum growth was the sole aim, one would fertilise prior to maximum growth periods. However, doing this would mean having to conserve more of the surpluses, at a cost.

Much more beneficial is to fertilise two months before the leanest period, to reduce the amount of conserved feed necessary - something many top farmers are already doing.

Whatever is applied, care must be taken to avoid creating imbalances, a major cause of animal health problems. Pasture analysing, backed by observation of the soils, pastures and animals, helps prevent this.

Those who keep applying phosphate and potash over long periods, without herbage testing and applying the trace elements required, can do their farms, animals and bank balance a lot of harm.

Getting complete fertiliser mixes is difficult in some countries. Prior to the 1960s in New Zealand it was almost impossible to get trace element fertiliser mixes. Farmers had to mix their own, or, in some cases, the fertiliser companies would have someone spread by hand the required trace elements on the truckload after it had loaded the fertiliser. Since the 1970s, however, every fertiliser company in New Zealand has made up trace element mixes, some with very sophisticated push button electronic dispensing and mixing. Charges vary from five to ten NZ dollars per total tonne of fertiliser mixed.

The first few companies to start this in the 1950's were sometimes branded organic cranks. In the last ten years not a single person in the country would speak like that, because all have seen the results of balanced fertilisers. Most fertiliser companies now sell at least one RPR. See RPR. There are some fertiliser companies selling RPR's in the States, and some are trying to do a good job but the vast distances can push freight costs go up. Factories that make superphosphate will be using a raw phosphate of some sort, but avoid buying a non-reactive one because it will be too slow to work. No RP works in alkaline soils. See Reactive Phosphates.

I suggest that you look into back hauling, even if you have to use trucks taking your stock away. Here there are half tonne and one tonne bags which can be lifted by cranes or tractors with front end loaders on a ramp into and out of stock trucks. The dividing gates would have to be opened. Combine with neighbours to get better buying and hauling prices.

Most farmers buy retail and sell wholesale, a recipe for high costs and low profit. Farmers are the only ones who can change this by bulk buying. Don't set up massive buying structures with overheads. Here many have been set up over the last 40 years, and almost all have failed because of inadequate capital, slow payers, bad debts and changes in buying habits of farmers following droughts, floods and downturns. Just combine to collect orders with deposits so there are no "pullouts", then get prices of anything required from fertiliser, seeds, water pipe to farm machinery and vehicles. Tractors and vehicles are difficult because farmers frequently have strong affiliation to their preferred brands.

Results of Balanced Fertilising

Animal health improves.

I noticed about a hundred paradise ducks on your back flats. They were taking off and landing back on your place so will be eating a lot of grass. With the improvement in soil and pasture health through lime and trace elements you can expect an increase in wild life. Ducks, Pukekos, rabbits, and hares will travel miles to your palatable pastures so will have to be controlled somehow.

Apply more salt in new grass fertiliser mixes to balance the high K uptake in new grasses caused by K being released after cultivation.

Fertilisers & Animal Health

Steve Osborne of Ngarua who had used Sechura for two years observed that a month after applying 400 kg/ha of 30% Potassic Super on a few paddocks, his cows, after grazing them, became scratchy and unsettled. Few people notice things like this, and of course it only happens if the farm has previously had a balanced fertilising program.

He told me last month that the 30% fertilised area grew no more pasture.

Robin and Louise Hodges of Otorohanga noticed the same after trying some potassic super, and worse still their milk dropped.

The Pukeroro Friesian cows would not graze a DAP fertilised pasture after being on Sechura ones. It had to made into silage.

An Ohaupo farmer had cows walk around in good looking pasture, but not eat. He had applied MAP to the paddock a month or two earlier.

Malcolm Clark of Patetonga noticed his cows became unsettled after using DAP slurry by helicopter.

Lance Bell of Maramarua noticed that his cows didn't like urea grown pasture and left a lot behind.

Fertilising New Pastures

Most new grass needs at least 1,000 kg/ha of a balanced mix to give it a good start to beat the weeds, and because, while deep cultivation is important, it lowers fertility levels in the top few inches. Poor soils need 1,200 kg/ha.

Leaching

Fertilising soil containing cracks prior to heavy rain periods (autumn) can increase the pollution of waterways, increasing the growth of algae and other aquatic plants in rivers.

The state of Florida budgeted US$500 million on a clean water programme mainly with their

sugarcane and vegetable farmers to reduce phosphorous runoff to the extent that only one eighth of what is applied is allowed to leach.

They aimed for 16,000 hectares of wetlands to reduce pollution into their Everglade natural swamps areas, and require farmers to reduce phosphorous runoff by 25%.

In 1964 Hogg and Cooper found that mixing superphosphate and potassium chloride (Potassic Super fertiliser) markedly increased potassium leaching. Don't ask me why this was not publicised, but possibly because of the large water soluble fertiliser lobby!

In 1984 Steele and others found increased losses of nitrates after applying nitrogen, associated with increased losses of calcium, magnesium, sodium and potassium.

In 1991 Heng and others from Massey University found much the same. Their Department of Soil Science measured the leaching of nitrogen, potassium, calcium, sulphur, magnesium, sodium and chlorine in two trials. They used field tiles so they could measure the drainage water before it entered the main drain. In a two-year trial, on a low fixation sulphur soil, they found that leaching of these elements was an average of 38% higher with superphosphate than with elemental sulphur and RPR.

The application of 50 kg of sulphate in 450 kg/ha Superphosphate in early winter gave a five times increase in leaching.

These results agree with the field observations of Gregg and Goh in 1978 and with Smith in 1983, who found an increase in leaching after applying Single Superphosphate.

Australian and Indian research found the same, and promoted using a balance of lime, salt and potash (K) to reduce K leaching.

The first autumn rains gave the greatest increase in nitrate leaching, because levels had built up over the summer. Leaching of sodium and chlorine approximately equated that in rainfall.

The scientists recommended that, where sulphur was required, elemental sulphur and RPR or PAPR be used.

Interesting, isn't it. To avoid leaching, remember that deep topsoils (chisel ploughing deeply helps), with plenty earthworms, friable so absorbent, will hold more of the heavy rains, so will leach less.

Increasing the pH can increase the effective Cation Exchange Capacity (CEC) by 50%. This allows soils to retain more calcium, magnesium and potassium, and makes soils less susceptible to leaching.

Aluminium toxicity is a problem in many soils. It discourages deep rooting. It can be reduced by applying adequate calcium and phosphorus, deep cultivation and encouraging deep digging earthworms.

Most of the above scientists recommended that, where sulphur was required, elemental sulphur and RPR be used.

More fertiliser leaches from high rainfall area soils that need and profit from higher rates of fertiliser than lower rainfall areas. Arid areas seldom justify fertilising, unless there is an important trace element missing, such as cobalt.

From Te Kuiti MAF Trials
Fertiliser costs in cents/kg DM grown in the first year

Sechura	3.8	
Gafsa about	4.3	based on its known availability, not on trials.
North Carolina	4.4	
Arad	5.6	
Quinphos	7.5	

Using Nitrogen (N)

The use of nitrogen on pastures in NZ has increased in recent years, mainly because:

• It usually costs less to use N to increase pasture growth than to buy hay or other supplements.

• Increased stock numbers on many farms have increased the number of times when feed shortages occur, so N is used to alleviate these.

• The requirement to increase profitability, especially on smaller farms, by using N to allow more stock to be carried and to get through lean periods.

The decision to use nitrogen is often made fairly hastily, after it is obvious that a shortage of pasture is going to occur, but in this situation maximum growth is not achieved from the application of N. It is far better to measure and predict future pasture growth by feed budgeting, than to decide to use N after the feed shortage has occurred.

The old saying that grass grows grass applies more when trying to get the benefit out of applying nitrogen than at any other time.

Applying N to paddocks which have been grazed down to 1000 kg DM/ha or less will result in much of the nitrogen being leached, especially if heavy rain follows, before the grass has had time to take it up and turn it into growth. Applying it to pasture with about 1600 kg DM will give much better results, but, if the decision has been left too late, there may not be many paddocks with this amount of cover.

Frequent small amounts over a wider area give better long term results than larger amounts on small areas less often because too much makes clovers lazy so less productive and can cause other problems such as lowering earthworm numbers and creating imbalances in other elements. A better financial return is obtained from applying it to fertile paddocks with ample high fertility grasses.

New pastures usually need several dressings each time they start to go yellow.

Urea is most popular because it costs less per kg on N and was the only granulated one so is easier to spread. Ammonium Sulphate is now granulated. If sulphur is low use Ammonium Sulphate because nitrogen must have sulphur to work. ICI trials showed that applying salt with N had benefits. See Nitrogen.

Fertiliser Trials

Pasture responses from the Te Kuiti trials again show Sechura well ahead of other RPR's. Figures were based on equal amounts of P, NOT on an equal cost basis. Pasture production from RPR's, which have 50% more phosphorus, would have been 30 to 40% higher id applied on an equal cost basis, but as with most superphosphate comparisons, RPR's were disadvantaged. The first column below shows the percentage extra pasture grown, based on equal amounts of P applied. The second column shows the extra pasture grown based on equal cost of P/ha.

	P	$
Super	24%	24%
Sechura	16%	24%
North Carolina	12%	18%
Quinphos	9%	14%
Nauru	8%	13%
Arad	6%	10%

RPR costs per kg of DM grown in the first year

	c/kg DM	
Sechura	3.8	This shows it is twice as good as Quinphos.
Gafsa would be about	4.3	based on its known availabilty, not on trials.
North Carolina	4.4	
Arad	5.6	
Quinphos	7.5	

It is good that AgResearch have at last realised that more P and Ca are necessary to grow plenty of grass, but their estimates are still too low.

Fertilising pasture 20 years ago was a straightforward decision, because there were so few fertilisers available. Now there are a bewildering number available, with some promoted as we've never seen before, so for a farmer to decide which fertiliser to use is far from easy.

However, with today's accurate pasture analysing facilities and the knowledge of the pasture's and animals' requirements, it doesn't take long with a computer to calculate the required fertiliser and trace elements for various soils and animals.

Fertiliser is the highest annual cost for most farmers - up to $300/ha, and yet in many cases less time is spent on its planning than on deciding which semen to use, the cost of which is about $40/ha.

Most farmers understand parasite cycles, discuss their control programmes with their veterinarians, and achieve good control. However, when it comes to fertilisers, the ignorance is appalling, and worsening, mostly because of the extensive commercial promotion by the wide variety of fertiliser suppliers and researchers being sponsored by fertiliser companies.

Lime Too

In the past agricultural lime was applied at one ton per acre every five years, but again this has decreased, and in some cases is seldom applied, mostly because some people work on the wrong assumption that, if the pH is close to 6, lime is not required.

PH stands for potential hydrogen which has nothing to do with the calcium requirements of animals, clovers, soils and earthworms.

Those who have applied lime to paddocks which had become patchy in growth and cover because of a breakdown in the nitrogen cycle, through low calcium levels slowing clover growth, have been astounded at how the pasture has improved, and how the cows prefer it and graze more it evenly.

Setting up On-farm Fertiliser Trials

I suggest that you do your own fertiliser trials on your farms as follows -

• Make as many enquiries as possible from neighbours, fertiliser sales people and research centres. Ask people who travel the area and see the local farms, which fertilisers they believe grow most pasture, carry most stock, and have the healthiest animals. A semen sales person once told me that herds feeding a particular soluble mineral mix looked healthier than those not using it.

• Get a pasture analysis. See Pasture.

• Decide the fertiliser or fertilisers required.

Spread various types of fertilisers in two metre wide strips in the centre of different paddocks from the lane fence back exactly 20 metres into the paddock gradually decreasing the rate. When you go up and down the lane you can watch for responses.

Once you get an idea of what is what then do whole paddock trials at various rates and measure the annual yield per paddock by measuring before each grazing and again after, for year or longer. Also take pasture samples and have them analysed.

The enclosed results from a MAF survey are interesting.

Animal Based Fertilisers

Blood and bone fertilisers can make animals become excited to the extent that they break through fences. If animal residue fertilisers have to be used either use sheep ones for cattle and visa versa, or accustom the animals to the smell gradually.

Be careful to avoid spreading diseases.

Poultry & Broiler Manure

This helps build up organic matter in soils, which can be good after years of cropping, grows plenty of grass and seems to encourage clovers to the extent where bloat can be a problem after a few years of repeated applications. Some poultry manure includes litter (shavings, sawdust, paper, etc). The more litter it has the less value it is. Be careful that the litter is not toxic as is the case from some timber (eucalyptus, treated, etc.).

Don't exceed xxxxxx cubic metres per hectare per annum (cu yds/acre), analyse pastures to avoid excesses and correct deficiencies.

As with all animal manures, the fresher it is the better, unless composted completely.

Grazing animals will eat poultry manure so be careful to avoid diseases in poultry which can kill other animals. About a hundred cattle died on a farm in another country after feeding diseased poultry manure in concentrates.

Bill Dunlap, convenor of Grassfed Beef wrote-

“In many of the central North Carolina counties, the soils are very high in Iron and Aluminium; requiring high amounts of lime to neutralise the acidity. Many of these soils are very rocky and unsuitable for conventional row cropping. In the 1950s when commercial broiler production came to the area, it was a natural fit. Since chicken litter has a lot of unused phosphorus, it was adsorbed to the iron and aluminium and did not pollute the streams. Grass flourished as did the farmers.”

This research he sent was published in the USA Agronomy Journal in about 2010.

Previous studies only considered the economic value of the nitrogen, phosphorus and potassium in chicken litter, compared to that in synthetic fertilisers. Farmers know that chicken litter, an organic

fertiliser, is a better soil conditioner than synthetic fertilisers, but have never had a way to assign a number to the value of that benefit.
In their study, Towelled and colleagues figured the litter's value as a soil conditioner as an extra US$17/t litter. They calculated this by balancing the price tag of the nutrients in litter with its resulting higher yields, a reflection of its soil conditioning benefits.
They found that cotton yields peaked 12% higher with organic fertilisers, compared to peak yields with synthetic fertilisers. With all benefits factored in, they found that chicken litter has a value of about US $78/t, compared to US$61/t when figured by the traditional method.
The economic analyses also showed that farmers could further increase their profits by using less of either fertiliser than currently used for maximum yields, which is also good news for the environment.

Pig (Hog, Swine) manure

This can have an excess of copper, so monitor it and do as for Poultry Manure above.

As with all animal manures, the fresher it is the better, unless composted completely with lime to help hold its nitrogen and sulphur.

Liquid so-called fertilisers

Remember that liquids have a high proportion of water and very low percentages of the solid necessary elements.

An NZ judge at the end of a year-long court case brought by a liquid fertiliser company against the NZ Department of Agriculture, after hearing all evidence, said that the particular liquid fertiliser does not and cannot work.

The NZ agricultural industry urgently needs a fertiliser consumer service that does profit per kg of fertiliser bought trials.

Liquid Products sold as fertilisers, soil conditioners, etc.

Most liquids are sold by the litre or gallon rather than by the ton, and vendors say that you don't need much. Some concoctions made up by farmers from recommendations have killed pastures, so be careful and do small trial areas first, especially on orchards where some sprays have defoliated trees. Don't exceed recommended concentrations and pre and post-wash spray equipment thoroughly. See below.

Some chelated elements sprayed on to pasture have caused adverse effects. I am suspicious of all chelates and have seen poor results from chelates that cost a lot more.

Chelate companies criticise each other on Web -

“Making amino acid chelates is a difficult process and some products on the market claiming to be amino acid chelates are likely to be non-chelated salts (ionic compounds) instead. Be wary of other products claiming to be amino acid chelates: particularly those that contain more than about 6% by weight (liquid) or 18% (solid) of the element.”

Some liquid products cost $3,000 per 1,000 kg of dry matter (the rest is water) which is about seven times dearer than solid fertilisers. Some make pastures greener which pleases users who usually buy them to save money. Liquid products are usually fish and/or seaweed based which have to be preserved to stop them going bad, so are preserved with formalin or its equivalent. When spread on pastures the formalin kills the soil microbes which, when dead, release N which reduces future soil N levels. Repeated application of this type of liquid products without solid fertilisers gradually deplete the soil microbes and essential elements. One Northland fish and seaweed product farmer-agent had the brownest and poorest farm in the area and after about five years of using his company’s products he went broke.

Trials that I and others have done with liquid seaweed and fish products show an immediate response from dead soil microbes, but after a few years pasture growth drops drastically. I know of no farmer who has continued using any liquid product on its own for more than four years. My phone has gone dozens of times from farmers complaining about ‘not growing grass’ - after using liquids for a few years. When I tell them that I am not surprised, they are surprised because they had believed the

literature.

Some liquid product suppliers stipulate that “solid” fertilisers must also be used, but rather than this shotgun approach, it is better to analyse pastures and apply just what is needed in the right quantities.

A fish oil farm that failed. They are water soluble so run down the valleys which are a bit greener. Look at the pasture in foreground.

During low product prices some farmers in New Zealand apply liquid products to try to save money, but without success. They are cheap per hectare, but dear per tonne of fertiliser. They are not registered as fertilisers which have to have a certain percentages of minerals. I surveyed them in the 80s and no farmer I could find (except the farmers who were agents) used any for longer than four years.

Liquid products being fully water soluble give a quick response, but also wash down valleys as shown above.

A reason for the quick response is that, being seaweed and fish, they have to be preserved with powerful preservatives that kill soil microbes, which then release nitrogen. Some liquid product companies have denied this, but there is not enough quantity per hectare of anything else to achieve the rapid and short lived growth. This is why liquid products stop growing grass after a few years.

Pro-Gibb stimulates growth, but has no body so causes poor recovery and should not be used too often in a row.

A slight excess makes the plants go yellow, which is a sulphur deficiency sign, which is of course negative. Urea does the same.

A reason that Urea and Pro-Gibb fail with time, is because you can't continue to get much from nothing. Urea is made from air so has no body, contents or guts. Continued fast growth requires both nitrogen and sulphur, which is why Sulphate on Ammonia, on an equal cost basis, beats Urea every time, and is much more sustainable. However, the promotion of Urea is because Ballance owns the plant, charges a lot, and makes much more out of it than out of proper fertilisers.

A scientist presented a paper on mineral imbalances and built up a case for DCAD and foliar spraying minerals, however, the mineral levels in the pasture he produced were so low that it was no wonder that he got a visual response of low true value dry matter. The weight is mostly in the moisture which is 90% of many plants.

Even if effective, liquids are much more expensive per kg of element applied and kg of pasture dry matter grown and cost more to apply, so while they may do a good job on house plants, small gardens and perhaps orchards, they are seldom cost effective or sustainable on pastures. Many farmers have phoned me and asked me to consult for them because their pasture was not growing. In most cases it was because they had changed to liquids two to three years previously.

Some vendors make pasture growth claims, which I'm sure are correct, but if the soil already had reasonable amounts of the main growth elements (P, K, S and Ca), the N in most liquids and the preservatives would give a boost to the grasses. Few pastures, even with good legumes, have enough N for the maximum possible growth. Modern grasses yield more so need more N than even white clovers can produce. The preservatives I refer to all items which stop seaweed and fish from decomposing and fermenting in the containers. When they are applied to pastures or soils they kill the soil organisms which releases N giving the pasture a temporary green boost. After a few applications without proper solid fertilisers, soils become depleted and pasture growth crashes.

These are expensive per tonne and per kg of dry matter grown. Farmers frequently try them when plagued with bloat and/or short of money because vendors quote low costs per hectare. Very few keep using them after a few years because pasture production drops.

It is easy to prove anything and to get responses, but it is the long term profit that counts. Remember that some researchers in a certain country told me, “Give us $100,000 and we can prove anything”. They do this by not mentioning what doesn't suit them, just to prove their point.

To qualify the above, I've seen and done dozens of comparative liquid trials on our lawn of dwarf perennial ryegrass which was well fertilised with all elements (it is only 400 sq. m so doesn't

cost much to keep it looking well), and ed (shown here at the back half of this paddock) It is the only liquid product I know of which improves growth, I believe partly because of its ability to reduce the leaching of N and so make it available for longer, and partly because it encourages better soil structure and better hair root growth. N-Fix is a soil improver, not a foliar fertiliser. It gives best results when sprayed onto soil before cultivating, especially with crops. N-Fix, somehow, retains mixture in the soil.

Foliar Absorption of Elements

This works under perfect conditions. They include adequate liquid and minimum evaporation - leaves won't absorb dry materials to any degree. Air temperature must be reasonably warm, but not so hot that the leaf stomatas close which they do during hot days.

Spraying is best done early in the morning or late in the evening when the leaves' stomatas are open so that they absorb elements.

Also see Inter-reactions by Elements to avoid conflict of elements.

kg (unless otherwise indicated) of Elements Removed by Harvesting

t/ha	N	P	K	S	Mg	Ca	Na	
Good hay	4	160	20	100	14	9	30	20
Good silage	3	140	15	80	10	7	24	16
Maize silage								
Maize grain								
Milk	1	6	1	2	1			

When hay and silage are fed out on paddocks the above elements, minus what animals use, are applied there. Grazed pasture and crops remove much less because animals return their manure. The exact amount depends on how long animals are on the paddock compared with how long in water and camping areas, lanes, yards and parlours.

File

Traditional Serpentine Super is made from single superphosphate (sulphuric acid treated apatite - as opposed to triple superphosphate which is made using phosphoric acid) just as it comes out of the den and before full acidulation has occurred), which is then mixed with ground serpentine (magnesium silicate). The 'hot' sulphuric acid then also acidulates the serpentine to provide an available magnesium source for plants as well as phosphorous and sulphur. In a broad sense it is a type of 'magnesium reverted superphosphate,' and although single super and triple superphosphates are very acidic (pH from1.5-4.5)and shouldn't have seed mixed with them, serpentine super is very mildly acidic (6-6.5 pH) from memory, and seed can be mixed with it. As a lot of dairying areas in NZ are becoming magnesium deficient, serpentine super is a valid option.

Serpentine super is around 7% P, 9% S, and 5% Mg. These are elemental analysis. To equate this to typical US and UK fertiliser ratings it is around 16% P_2O_5, 22% SO_3, and 9% MgO.

Fertilising is one of the major annual expenses on most NZ farms because being a new country geologically with most areas getting rainfall of more than 1,000 mm (40 inches) and up to 3,000 mm, soil fertility is low and most trace elements are very low.

World-wide, knowledge of what the various fertilisers do and how much of each is required is one of the least understood and least farmer studied subjects, so for many, which fertiliser mix is best for their farm is a mystery. Billions of dollars have been spent on fertiliser research by government research centres, universities and companies, but despite this farmers are confused about which products to use, who to believe and who to turn to for accurate and profitable advice. In fact very few can give this.

Generally most farmers world-wide know more about bull semen, worm drenches and parasite control than about the technicality of fertilising, partly because scientists and sales people also know little about the subject, shown by the fact that they quite often argue between themselves about how

much of what to apply. Soil testing laboratories give widely varying recommendations from soil analyses from identical soil samples.

The first rule is to correct and feed the soil not the pasture, and the soil will feed the pasture. This means correct drainage, correct liming to bring the calcium levels up to the optimum (see Pastures) and the pH to at least 6 in most soils (see Soils).

The second rule is to boost pasture growth about six weeks before needing it. Excess pasture in spring is an expensive liability (unless needed for conserved winter feed in snow covered areas). This book is about profiting from grazing so the information is aimed at achieving this with a minimum of conservation and feeding supplements, which means managing and fertilising to get pasture growth as even as possible over the year with variations to suit animal numbers which can change to profit from supply and demand animal prices.

The third rule is to achieve optimum animal health which means avoiding high nitrates and getting mineral balances right.

The fourth rule is to make up fertilisers on information from your farm for your animals under your rainfall and stocking rates, not from a university a hundred or more miles away.

The fifth is to feed the pasture or forage crop to the best advantage. Pasture without legumes needs more N while that with legumes needs more Ca, Co, Mo, etc. Brassica crops might need iodine to avoid deficiencies in animals although feeding it direct to the animals via a dispenser is best.

One must also decide whether to fertilise or feed deficient minerals.

What is best for one farm may not be best for one over the hill or with different animals. Also what is to being grown (pastures or forage crops), organic matter level and how “alive” the soil is, all influence what should be applied.

Some elements are antagonistic to each other - too much of one can lower another. A common example of this is how high potassium levels lower the sodium and magnesium content of pastures, causing cows to suffer metabolic problems because of high potassium and low magnesium, and animals eat soil and lick each other to get some salt.

Potassium also lowers boron, an essential element for the assimilation of calcium. Boron also helps soil life and condition, pasture sugar levels (energy) and animal health.

When New Zealand basic slag became available, many farmers, remembering the enthusiasm some had for the old imported Belgian basic slag, tried the local product, but with most unfortunate results of poisoned animals in some cases.

Until the late 90’s the NZ Department of Agriculture openly criticised everything except the conventional superphosphate and muriate of potash, however, more and more farmers were getting equal, and in some cases better, results with the best raw phosphate (Sechura from Peru) called reactive phosphate (RP) in New Zealand.

Sechura is a marine phosphate with the elements of the sea. It is extremely fine which is essential for availability without using sulphuric acid as in superphosphate. Its analysis is -

%	%	%	%	%	%	ppm	%	ppm	
P	K	S	Mg	CaCo3		Ca	A	Al	Cd
13	0.01	1.60	0.32	33.4	13.6	5	0.36	11	

ppm	ppm	%	%	ppm	ppm	%	ppm	ppm
Co	Cu	F	Fe	Mn	Mo	Na	U	Zn
3	6	3.4	0.32	91	30	1.60	72	178

You might wonder why the level of cadmium (Cd) should be listed. It is a highly toxic element which has been high (60 ppm) in some fertilisers now not imported. There are no regulations regarding the levels in fertilisers, so it is buyer beware unless you want a farm polluted with it and perhaps end up in the same situation as the farms polluted with DDT which are not allowed to supply milk.

Most RPR’s have 13% phosphorus (P) the most important pasture growth element. This is 44% more than in NZ Single Superphosphate which has 9% P. RPR’s cost less per kg of P than Superphosphate. Superphosphate has 11% water soluble sulphate sulphur which leaches and takes some elements with it.

Raw phosphate (RP) is what is used to make Superphosphate by mixing it with sulphuric acid.

RPR's are not rocks, but powder. The finer it is the better. If it is coarse is will be slow to become available. It should be pointed out that the worst RPR is virtually useless because the coarsest (large granules) can take up to 40 years to become available to plants - even in acid soils with a high rainfall.

Up until a few decades ago most advisors knew little about fertilisers other than Superphosphate, potash and Olsen P and other soil tests. To many, everything else was "muck and magic", a typical statement from scientifically trained academics. Most department of agriculture staff criticised the growing system in private enterprise of analysing pastures to decide which of 16 elements were short - and which were in abundance, an equally important aspect.

If all scientists had had open minds - as they surely should have - they might have come up with answers like those listed below, which would have had much more credibility than the statements many did make, which in general could be summed up as - "Everything except the then common 15% or 30% potassic super is a waste of money". Most preferred 30% which meant that less phosphate was applied and it cost more.

Farmers should do their own tests and trials. A MAF statement that "The farmer does not have the inclination, resources or training to conduct proper field trials..." is far from correct. Many farmers certainly do have the inclination, resources and ability to conduct fertiliser trials on their farms, and in many cases are doing so, using dry matter measuring with a Pasture Gauge or just by counting the grazing days and/or bales of hay produced, with the result that in NZ sales of good reactive phosphates are increasing because on an equal dollar basis it grows more pasture in many soils. The NZ Department of Agriculture Te Kuiti trials showed that DM yields per dollar were cheapest with Sechura phosphate. If a soil is sick or dead, even a good reactive phosphate will not work until the soil is livened with whatever is lacking most, which is usually lime, poor drainage and any other deficient element. Water soluble fertilisers (NOT LIQUID ONES) such as Superphosphate and/or diammonium phosphate (DAP) are best used in these cases, with all deficient elements until the soil and pasture starts to thrive.

A ground up DAP mixed with water and called DAP Slurry applied by helicopter in small amounts was sold for a while, but farmers soon discovered that it was not economical because not enough was applied and the helicopter costs made it uneconomical. Had farmers put the analysis and quantity applied per hectare into a calculator they would have not wasted their money on it even once. If the helicopter cost is greater than the product cost, it is uneconomic.

Corrections for so called 'fertiliser experts'

A farmer wrote, "I have had Ruakura and other so-called experts tell me that there is ample Ca in our soils so liming for increased herbage Ca is a waste. What they don't explain is why my soil Ca levels dropped from 8 to 4 after 5 years of applying DAP instead of Superphosphate. Our soil Ca levels are now rising with liming. Also clover has higher Ca levels than ryegrass, so the increase in clovers that happens after applying LimeMagPlus, the average pasture Ca must rise. Ryegrass tissue on its own can go from 0.5% to 0.8%, which is the optimum level.

There have been dozens, if not hundreds, write the same to me. Meanwhile MAF, Ruakura, AgResearch and DairyNZ sleep on the $10 million dairy farmers have taken from them annually, and certainly don't do trials between equal cost per hectare of fertilisers and LimeMagPlus applications.

Most farmers now know that fertiliser companies sponsor researchers to find fault with liming.

The first thing researchers, and some farmers must learn is that agricultural lime **without** serpentine, OrganiBOR and deficient trace elements, is almost a waste, because lime lowers boron which is low in all NZ and USA soils, and zinc. Zinc is also low in most NZ soils which is why our government has subsidised it for human consumption in the form of Zincaps, from a doctor's prescription to chemists. Fortunately Zincaps have less mercury than most other zincs. Some specialist zincs are toxically high in mercury and cadmium.

Silicon

While on soils, most NZ soils have a lot of silicon. It is the second highest mineral in most soils, after aluminium, so don't pay your hard earned income on buying it from the myriad of sales people

who fleece some farmers.

Adding to the paragraphs above; agricultural lime reduces aluminium (a cause of hard soils) from stopping ryegrass and maize roots, and others less so, going down for fertility and moisture, reducing their yields by 50% or more. To work, lime must ALWAYS be applied with other deficient elements.

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