agKnowledge
TNM™ "Total Nutrient Management"
October 1998

THE Fertiliser Review

ISSUE 1

At last... objective, unbiased information is at hand

EDITORIAL

Fertilisers still remain the largest item of discretionary expenditure in most farm budgets. How well the fertiliser dollar is spent often has a large impact on farm production and profitability. Despite this the farmer is probably more confused than ever about which products to use and who to turn to for objective impartial advice.

This is a consequence of the free-market reforms.

There are now many fertiliser products and services available. This is good. The downside is that the farmer is bombarded with salesmen, advertisements and advertorial comment, much of it unsolicited. This is frequently confusing.

Recent information from the Livestock Improvement Corporation (LIC) has highlighted the dilemma. Their survey results show that while the top 25% of dairy farmers are spending about 25-30 cents on fertiliser per kg MS produced, most farmers are spending much more and achieving lower levels of production! Why should this be if farmers are not confused about which products are most cost effective?

The problem is confounded with the disappearance of the old advisory networks, such as the MAF Advisory Service, which provided impartial scientific information and analysis on the agronomic performance of fertilisers. Who does the farmer turn to now?

To make matters worse science agencies such as AgResearch, which replaced the MAF Research Division, are no longer committed to this type of work. Not only the farmer but also the farm consultant is being starved of sound scientific information. "**The Fertiliser Review**" is designed to fill this science and information vacuum. It will be produced in October and March each year and will provide information on fertiliser products and prices and related services, together with commentary and opinion on the latest science.

ABOUT THE AUTHOR

Dr D C Edmeades
MSc (Hons), PhD, Dip Management.

Dr Edmeades commenced his science career in 1977 when he was appointed as a soil scientist to MAF Ruakura. Initially his research interests were on soil acidity and liming. In 1985 he was awarded an ANZAC Fellowship and spent a year at the University of Queensland studying the effects of aluminium toxicity on pasture plant growth.

In 1988 he was appointed Group Leader (Soils and Fertilisers) at Ruakura and in 1991 became the National Science Program Leader (Soils and Fertiliser) in the newly formed AgResearch. In this role he had a major influence on restructuring soils and fertiliser research making it more relevant to end-users and involving industry participation.

Dr Edmeades has published over 85 scientific papers, several books, booklets and pamphlets and countless popular articles. He has appeared on TV and on videos.

In 1997 he left AgResearch to complete a management degree and commence his own science consulting business. Recently he has established **Fertiliser Information Services Ltd** as a vehicle to produce and publish scientific information on fertilisers and soil nutrient management. This newsletter "**The Fertiliser Review**" and the booklet "**Fertiliser Facts And Fallacies**" (see article) are the first steps in this development.

COST OF NUTRIENTS

Of the major nutrients phosphorus (P) is the most expensive. At current prices potassium (K) costs about 66 cents/kg, sulphur (S) 40 cents/kg and nitrogen (N) 80 cents/kg. In comparison P costs over $ 1.0, depending on which product you buy.

So if you are concerned about keeping fertiliser cost down a good starting point is look at which type of P fertiliser to buy.

Superphosphate contains both P and S so if we deduct the value of the S we can determine the cost of the P. If you are buying super at $160 / tonne then the cost of the P is $1.20/kg. Doing the same sort of calculation for DAP and this time deducting the value of the N we find that the P costs about $1.60. For RPR it is about $1.30 and for triple super $2.10.

These figures are based on ex works prices. In principle it is less expensive to cart products with a higher analysis. Less material needs to be transported. This will favour DAP and triple super.

Repeating the above calculations using prices 150 km from the works resulted in the following: super $1.41, RPR, $1.53. DAP, $1.66 and triple $2.20. In other words the relative cost per unit of P is still about the same.

The message is quite clear. Super is, based on today's prices, the cheapest form of P. It does of course contain S. You can't have one without the other. But most soils need both P and S for both development and maintenance. So super is at present the product of choice in most situations.

MAXICROP IS BACK

Do you recall the High Court Case regarding Maxicrop? MAF was sued for $11m by the Bell-Booth Group for allegedly defaming it's product Maxicrop. After hearing the evidence of 20 scientists His Honour Justice Ellis ruled that the product (including all the variants) could not (based on what it contains) and did not (based on the field trial results) work.

It is interesting therefore to see the product back in the market. A product brochure dated September 1997 states "It's with great pleasure that the return of Maxicrop to the New Zealand home garden market is announced".

The brochure goes on to make various claims regarding the efficacy of the product, contradicting the High Court judgement.

A further brochure introduces a new product COMBO. According to this brochure "Combo is the combination of two products; Supa Crop Liquid Humus (10.5.6) and Maxicrop Triple". The nutrient analysis is given as 10% N, 5% P and 6%K. It is claimed also to contain trace elements, and plant growth substances.

The recommended application rate is 10 litres/ha. Based on the analysis above this will supply about 1 kg N/ha, 0.5 kg P/ha and 0.6 kg K/ha. Not the sort of product I would recommend if you were intending to build or maintain soil nutrient levels!

One thing is intriguing. During the Court case a scientist from the UK gave evidence to the Court. He had done many trials, about 40, with Maxicrop Triple on a whole range of crops. He compared Maxicrop Triple with the same amount of water and found no difference. So why include Maxicrop Triple in Combo? Perhaps you should ask the salesman when he calls!

THE P FIXATION BOGEY

No other concept in soil science has been so misrepresented and misused as soil P fixation. It has been and still is used to sell all sorts of useless fertiliser and soil amendments to unsuspecting farmers.

For example, I have heard it said that it is a bad thing and that farmers should do everything they can to minimise it. I've seen a phosphate retention (PR) test of 90% interpreted to mean that 90% of the fertiliser P applied will be locked up in the soil and be unavailable for plant growth. This is nonsense. Farmers need to appreciate this.

When fertiliser P is applied to the soil it undergoes a number of transformations. Some is taken up by plants and subsequently returned to the soil as plant residues and excreta. Some is consumed by organisms. Some reacts with active soil minerals such as iron and aluminium oxides.

Over time virtually all fertiliser P whether applied in a soluble or slow release form, is converted into either inorganic or organic P in the soil. It becomes "fixed".

This inorganic and organic P cannot be taken up directly by plants and makes up about 99% of the total P in the

soil. The amount of P in a soluble plant available form at any one time is very small.

However this does not mean that this "fixed P" is unavailable for plant growth for ever. By the processes of mineralization and equilibration, soil reactions mentioned above are reversible. The "fixed P" is converted back to soluble plant-available P as required by the plant. The fixed P becomes unfixed.

While P is in the insoluble fixed forms it cannot be leached. Thus "P fixation" should be seen as a good thing. It is nature's way of storing P and making it slowly available for plant growth.

"P fixation" should be seen as a good thing. It is nature's way of storing P and making it slowly available for plant growth.

The PR test (now called the Anion Storage Capacity ASC) simply measures the relative amount of active iron and aluminium in soils. It measures in effect the potential of the soil to store P. It is a property of a soil and is not affected by liming or other soil management factors.

REACTIVE PHOSPHATE ROCKS

Are all reactive phosphate rocks (RPRs) equal? Not according to recent trials completed by AgResearch. Two trials, one in the King Country and the other in Southland compared the agronomic effectiveness of a number of phosphate rocks (PR), including several RPRs, against superphosphate over 3 years (Table 1).

Table 1. The relative agronomic effectiveness of phosphate rocks (PR) and reactive phosphate rocks (RPR). Mean over 3 years. (Superphosphate = 100)

Product	Site	
	Te Kuiti (King Country)	**Woodlands** (Southland)
Superphosphate	100	100
Sechura RPR	78.7	87.5
North Carolina RPR	61.4	85.9
Arad RPR	44.9	50.0
Egyptian RPR	37.1	39.0
Zin PR	25.7	39.7
Nauru PR	39.1	35.0

Source: NZ Pastoral Research Institute

Notes: All the RPRs and the Zin PR were applied as received from their respective sources. The Nauru PR was ground to 100% < 250 microns.

The pasture dry matter responses were in the order: Super > Sechura > North Carolina >> Arad > Egyptian ~ Zin ~ Nauru

Pasture P uptake and P concentrations also followed this order.

These results confirm previous research findings showing that Sechura and North Carolina are suitable for direct application but that even after 3 years neither of these products matched the performance of superphosphate.

My advice? RPR's are best used when soil P levels are at or above the optimum. They are maintenance fertilisers. They are not the best products to use where the intention is to build up soil P levels. If you decide to use an RPR then the above data makes it very clear as to which product to use.

LIME-REVERTED SUPERPHOSPHATE

There is increasing interest in reverted superphosphate. There are a number of possible reasons for this but the major factor appears to be that superphosphate is regarded as an acid fertiliser and therefore has detrimental effects on the soil.

Is Superphosphate Acid?

Super is made by reacting phosphate rock with sulphuric acid. This is done to make the P in the rock plant available. If it is properly made and cured most of the acid is used up. There is very little left in the product, typically 1.2-1.4 %.

What does this mean in practice? Certainly if you add a little water to a few granules of super in a cup and measure the pH it will be acid, about 2-3 pH units. This is why super should not be sown "down-the shute" with many seeds. This acidity can damage the emerging seedling. It is also this acidity that causes super to rot jute bags.

Practical Effects?

What then is the effect of this acidity on the soil? Does it affect the soil pH and is this a permanent effect?

Taking this worst case scenario, if super was applied to provide a typical maintenance dressing of 50 kg P/ha (ie 550 kg super/ha) this would add to the soil the amount of acid that would require about 6-8 kg pure limestone to neutralise.

Putting this in context, we know that 1000 kg of pure limestone/ha is required to raise the soil pH by about 0.1 unit. The acid in a typical dressing of super is equivalent to < 1% of this. So at worst the soil pH may drop by < 0.001 of a pH unit. In effect it is something akin to adding a teaspoon of concentrated acid to a swimming pool!

In practice such changes are too small to be observed in the field. This is exactly what is found in long-term trials. Annual inputs of super over many years (20-30 years) have no practical effect on soil pH.

Claims for Reverted Super?

In addition to neutralising any excess acid, the process of reversion (whether done with limestone, serpentine or dolomite) also changes the chemical form of the P. In super virtually all the P is present as highly soluble mono-calcium phosphate. In reverted products it is largely present in the less soluble di-calcium phosphate form.

Thus about 85% of the total P in superphosphate is water soluble but this is reduced to about 10-20% in reverted products.

A further change occurs when either serpentine or dolomite is used in the reversion process. The Mg contained in these minerals ends up in final reverted product which then becomes a source of plant available Mg as well as P and S.

It is claimed by some that di-calcium P is less likely to be "fixed" in the soil and that less is leached. In short, it is claimed that the P in reverted super is more efficient - it grows more DM/kg P applied.

Field Trial Evidence?

There have been many trials (11) comparing the agronomic effectiveness of reverted super products (including the traditional lime, serpentine and dolomite reverted products and proprietary brands such as dicalcic super [wet-mix 50:50 lime:super mix]) with soluble P products including super. Typical results are as given below.

The key conclusions from these trials are:

- When compared on an equal weight of P basis, reverted superphosphates are agronomically (kg DM/kg P applied) no better than soluble P fertilisers such as super.
- Lime: super mixtures such as dicalcic are agronomically no better than can be achieve by applying the 2 components separately
- There is some evidence that reverted super may be more efficient than soluble P on soils with low ASC (< 20) under high rainfall (>2000mm) such as the pakahi soils on the West Coast. (ie soils in which P leaching may occur).

Typical Field Trial Results

Some typical are shown in Table 2:

Table 2: Effect of super, dicalcic super and super + lime mixtures on pasture production.

Treatment	Yield (kg DM/ha/yr) Mean of 5 trials
Control	7000
Super (125 kg/ha)	7890
Super (250 kg/ha)	8550
Dicalcic (250 kg/ha)[1]	7656
Super (125 kg/ha) + lime (125 kg/ha)	7976
Super/dolomite (250 kg/ha)[2]	7814

Source: NZ Pastoral Research Institute

Notes: 1) 50:50 lime/super wet mix
2) 50:50 dolomite/super mix

Why Use Reverted Super?

It follows from the above that the only objective reasons for using reverted super products are:

- When such products are cheaper ($/kg of P) than soluble P. This is not generally the case.
- When a source of Mg is required. In this case serpentine or dolomite reverted super may be considered. But consider also the cost of other sources of P and Mg applied separately or together.
- Under situations where leaching of P is known to occur. Present evidence is that this is confined to the Northland podzols and the West Coast pakahi soils.

PRESCRIPTION FERTILISERS (NZ) LTD

This company and its products have featured frequently in the farming press over the last 6 months. What is the "Script Fertiliser System" and the products they are promoting?

According to the information I have received Prescription Fertilisers (NZ) Ltd market a range of fertilisers (called Script) with various NPKS and trace element compositions. They also market a liming product (Aqualime). These are sold as 100% soluble powders but must be diluted with water for application.

It is claimed that they are unique because they contain patented protective chemicals. When they (the fertiliser or lime) comes into contact with either the plant or the soil a gel, referred to as a mucilage gel, is formed encapsulating the nutrients. Accordingly it is claimed that these protective materials (the gels) prevent the nutrients from leaching, runoff and chemical fixation. Consequently smaller inputs of nutrients are sufficient to achieve the same level of production as conventional fertilisers.

If these claims are true then this would indeed be a wonderful discovery. It would mean lower fertiliser costs and little environmental contamination. For this reason the idea deserves scrutiny.

With this in mind I recently met with the principals of the company. While their theories and ideas were interesting (at least to a soil scientist) they were unable to provide me with "hard data" to substantiate the claims made for their products.

Photographs of crops and soils, with and without Script products applied, were presented. Also, I was shown soil test results taken before, and some years after, Script products were applied. In my view such information, no matter how "compelling", does not represent proof that the claims are valid.

My standard, and the standard progressive farmers should demand from any company selling fertilisers, is to see the results from properly designed and replicated experiments. Until such information is forthcoming I remain skeptical.

My advice if the salesman calls? Ask to see "the data". If a folder of photos or soil test results comes out, or your ears become filled with lots of scientific sounding words, tell him you have got some urgent farm work – remember to take the cheque book with you!

YOUR QUERIES

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

Contact:

FERTILISER INFORMATION SERVICES LTD

Freephone : **0800 FERT INFO** (0800 33 73 46)

Email: **enquiries@agknowledge.co.nz**

Post: **PO Box 9147**
Hamilton
New Zealand

FERTILISER FACTS & FALLACIES

The booklet "**Fertiliser Facts & Fallacies**" written by Dr Edmeades provides in plain language the facts which contradict 50 common fallacies which are used by some salesmen to sell their products.

Be a top quartile farmer.
Order your copy.

$15

Contact:

Fertiliser TECHNOLOGY SERVICES

Freephone : **0800 FERT INFO** (0800 33 73 46)

Email: **enquiries@agknowledge.co.nz**

Post: **PO Box 9147**
Hamilton
New Zealand

Science Based Knowledge

Technology Transfer

Optimise Productivity

- **Optimise farm profitability**
- **Make your fertiliser dollar go further**
- **Decrease your farm's environmental footprint**

Indepen nt

Effic

Practical Experience

Sustainability

Dr Doug Edmeades

THE Fertiliser Review

ISSUE 1