agKnowledge
"The Independent Fertiliser Experts"

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REGENERATIVE AGRICULTURE – THE FIRST SHOTS HAVE BEEN FIRED

An Experiment

A project, funded by The Rural Professionals Fund, has been completed. The goal of the project was to "test the hypothesis that regenerative farming produces cattle with better meat quality compared to equivalent conventionally finished animals and is associated with increased pasture diversity."

Animals from 9 conventional farms were paired with nine farms 'considered' to be farmed Regeneratively. One animal from each farm was paired by breed, sex and age. Thus the experiment unit comprised nine paired animals. A range of tests were conducted on the striploin for each animal. Meat quality was assessed by measuring pH, moisture, elemental analysis, fat-soluble vitamins, intramuscular fatty acid profile and colour.

The conclusion: Most tests showed no significant difference between farm types in the levels of fatty acids considered to be beneficial to human health.

The pastures from each of the farms were also examined and the major difference was the clover content. The conventional farms had lower clover content (4%) relative to the regenerative farms (13%). This was attributed to differences in fertiliser use, noting that the regenerative farms did not use synthetic fertiliser and the nutrients on the regenerative farms were applied as fish hydrolysates, RPR, lime, potassium sulphate and humates.

These results are heavily qualified in the report: "It (i.e. the results) can only be considered a snap shot to show where further research would be useful." Meekly, it is suggested that "knowing where the two farm types don't differ is just as important as where they do."

Needless to say further research is suggested including:

- Research to look at the 'long-term effects of different fertiliser programs on botanical composition, pasture performance, soil quality, environmental indicators and meat quality.'
- More robust trials with greater numbers of animals and 'tighter controls over selection, pairing and management of meat quality comparisons.'
- Further investigation of the impact of clover content and meat quality.

Commentary

The first question is: why bother with such a poorly designed 'trial.' I wonder whether input from a biometrician was sought to ensure that the design (number of animals etc) was a robust test of the hypothesis? After all the report does say '……with the large number of variables considered, this trial was only designed to pick up major differences…' Ironically, does this mean that regenerative farming does not have major effects on meat quality? This is after all a foundational claim made for regenerative farming!

Further research is suggested to look at the long-term effects of different fertiliser programs – one assumes to compare the regenerative fertiliser policies with conventional fertiliser programs. I'm confident that we already have enough science 'in the can' to predict the long term consequences of using fish hydrolysates, RPR, lime, potassium sulphate and humates on pasture production and composition, relative to using conventional fertilisers. Surely we do not need to repeat this past research.

One last comment. It seems to me that the decisions now being made about what science is required in respect to regenerative agriculture, are being driven by a generation of young scientists who have no training in agricultural science and/or very little knowledge of the history of agriculture science. In their naivety, they are being informed and motivated by people from either the organic movement and/or the extreme environmentalist camp, who see Regenerative Agriculture as a huge opportunity to push their own dogmas into the fabric of agricultural science in New Zealand.

This situation places science, in this case agricultural research, in an invidious position – science is being used as a commodity to support a dogma. It is also, as the example above demonstrates, a huge waste of R & D resources.

WHITE CLOVER – WELCOME BACK?

With the cap on nitrogen fertiliser use, and the recent hike in urea prices, white clover should come back into prominence. I say 'should' because there is no certainty that it will. We have a lot of things to re-learn.

There was a time, pre-weevil, pre-urea and feed supplements, when growing high quality clover-based pasture was 'par for the course.' It is what we (the New Zealand farmer) did and did well. You can hear echoes of this when young farmers speak fondly of the clover-based pastures that Dad recalls. But I think this generation of farmers have either not learned, or have forgotten, how to grow and maintain white clover pastures. Hence the need for some reminders.

VALUE OF FIXED NITROGEN

Clover-ryegrass is the cheapest feed available for ruminants. The marginal cost of a kg clover-ryegrass dry-matter is about 4-5 cents/kg, compared to grass-alone grown with fertiliser N at 10-12 cents/kg DM, crops (15-20 cents/kg DM) and supplements at > 30 cents.

That is one way to value clover. But remember clover is a legume and fixes free nitrogen from the atmosphere. With appropriate assumptions the value of the fixed N is estimated to be about $210/ha/yr and $98/ha/yr for dairy and drystock pastures respectively (Table 1). Assuming that the average dairy farm is 100 ha this amounts to $21,000 worth of fixed N per annum. For an average drystock operation (300 ha) the comparable figure is $29,000. In the absence of clover on-farm costs would need to increase by these amounts to purchase fertiliser N to maintain the same production. At a national scale the total value of the N fixed by clover is about $3.4b

Table 2. Value of the nitrogen (N) fixed by clover

Item	Dairying	Drystock
Average pasture production (kg DM/yr)	15,000	7,000
Clover production (kg DM/ha)[1]	5250	2450
Clover N (kg N/ha/yr)[2]	210	98
Value of clover N ($/ha)[3]	541	252
Area (m ha)	2.4	8.7
Total value of fixed N ($b)	1.3	2.1

Notes: 1) assuming 35% clover
2) assuming 0.4% N in clover and 100% fixed.
3) assuming $2.58/kg N ex works

VALUE OF ANIMAL PRODUCTION

Clover does more than add N into our pastoral system. Animal production per unit of dry-matter consumed is higher from clover that from grasses. This has been measured in many studies. For example, Figure 1 shows the relationship between animal production (in this case milk yield) and the clover content (%) of the pasture, from a trial at Ruakura. Production increased with increasing clover content up to about 50%.

This benefit of clover was due, not only to the higher nutritive value of clover relative to grasses, but also the greater intake of clover DM. These effects can be large. In this experiment increasing the clover content from zero to 50% increased milk solids by about 25-30%.

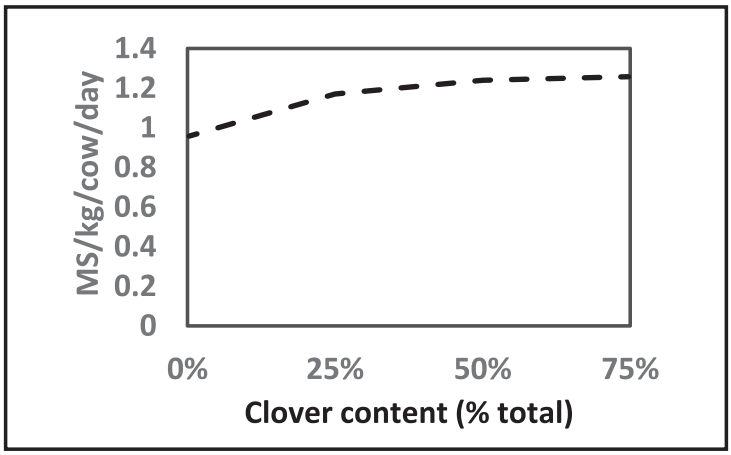
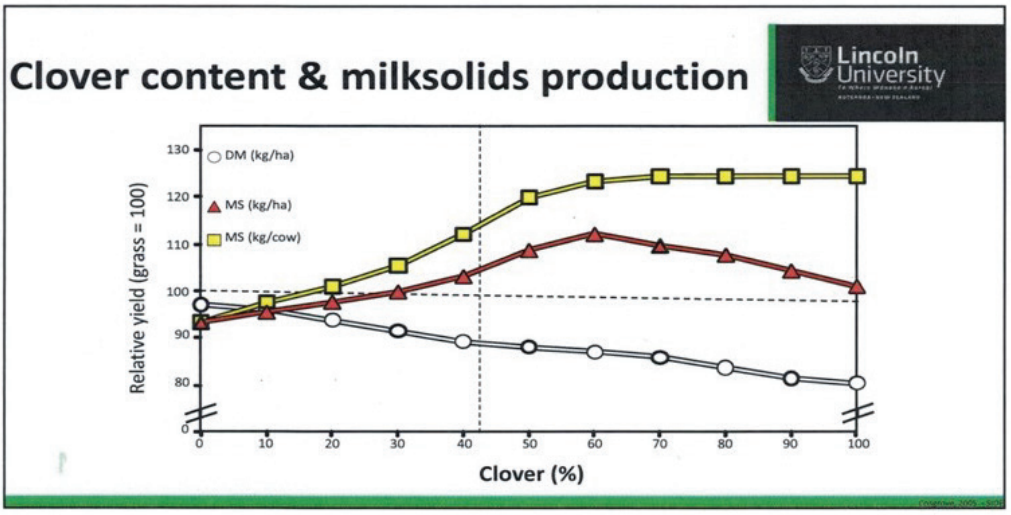


Figure 1 The relationship between pasture clover content and milk production in a trial at Ruakura (from Harris et al. 1997).

The effect of clover is not linear, and in this experiment, increasing the clover content from 50% to 75% had no further effect on milk production. The reason for this becomes apparent from a set of data from Cosgrove (2005) (Figure 2). Production per cow and per hectare increased with increasing clover content in this case up to about 60%, but as the clover content increased further, production per cow plateaued and production per hectare decreased. This later effect arises because the grass production (and hence total DM production (clover plus grass) decreases with increasing clover content. For reference a picture of what a 40% clover pasture looks like is included. This would equate to a 9-10/10 pasture applying the Pasture Visual Assessment scheme to be discussed later.



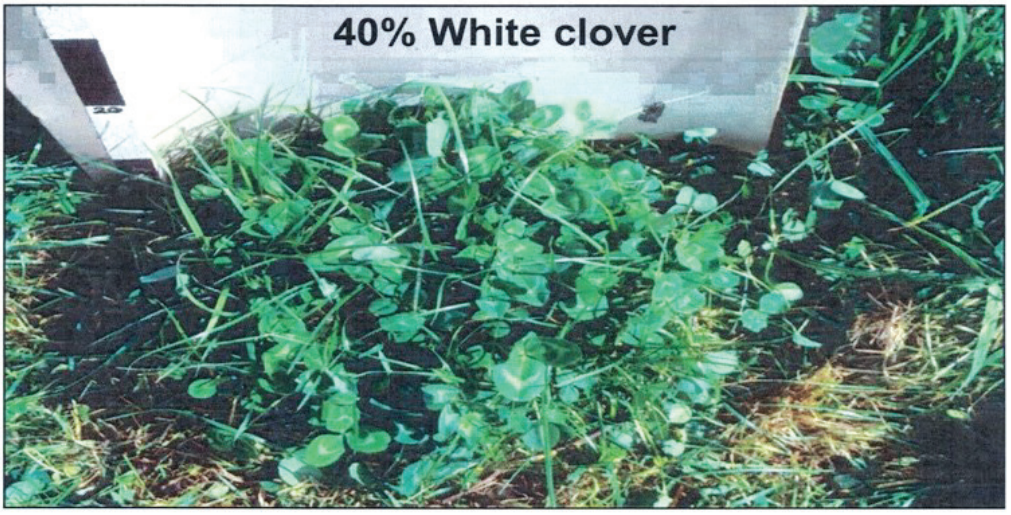


Figure 2 The effect of pasture clover content on pasture and milk solids production (Cosgrove 2005).

These results suggest that the ideal clover content is about 50-60% but, as Harris et al. explained, it is very difficult to maintain pastures with a clover content consistently above 50% given the vagaries of the climate, and hence they pragmatically suggested that the ideal New Zealand pasture should contain about 30-40% clover.

This effect of clover has been measured in other studies. A general relationship between pasture white clover content and milk solids (kg MS/ha) has been derived from a meta-analysis, consolidating results from many trials conducted internationally (Figure 3).

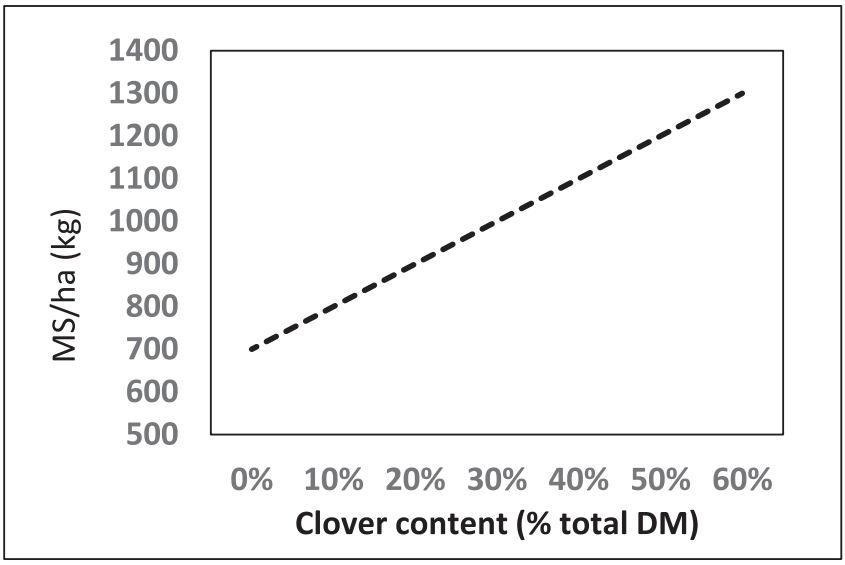


Figure 3 The modelled relationship between pasture clover content and milk production derived from a meta-analysis of international trials (from Dineen et al. 2017).

Assuming that this generalised relationship can be applied to the New Zealand situation, the slope of this relationship suggests that production per ha increases by 100 kg MS/ha for each 10% increase in clover content up to 60%.

We know that the clover content of many of our dairy pastures is poor (about 15% - see Fertiliser Review No 44). If the ideal clover content of pasture is about 30%-40% (say 35%), we can estimate from the above that the likely increase in MS production/ha arising from increasing the clover content from about 15% to the optimal of 35%, will be about 800 to 1000 – an increase of about 25%. This is roughly consistent with the results from Figure 1.

Thus, the direct effect of clover production on the dairy industry is large. Assuming an increase of 200 kg/ha MS accruing by optimising the clover content of current pastures, represents an increase of $1800/ha (at $9 kg MS) or about $4b annually for the whole dairy industry. It is likely that increasing the clover content of the pastures in the sheep & beef sector would have similar effects thus adding a further quantum to the value of clover to our pastoral sector.

PASTURE VISUAL ASSESSMENT (PVA)

Given its huge economic importance to our pastoral sector it is surprising we have lost 'sight' of how to grow quality ryegrass-clover pastures. Part of the problem is that we now have a generation of farmers who do not have a 'mental picture' of what a good clover pasture should look like. Some explanation is required.

Going back 30-40 years MAF Research Division conducted many fertiliser field trials looking at the effects of various nutrients on pasture production and composition. Farmers as I recall loved visiting these sites and it is likely that they got the clear mental picture of what a good pasture, unlimited by nutrient deficiencies looked like – they applied this knowledge to their farms.

We no longer do this sort of trial work and hence we have a generation of farmers who do not have this background knowledge. I see the consequences.

During farm visits I will ask a farmer to show me his worst and best pastures. Sure, the bad pastures are bad and the good pastures are better – in the context of his farm these are the best pastures. BUT in the broader context they are by no means close to the ideal (e.g. 30% - 40% clover).

For this reason, agKnowledge has developed a Pasture Visual Assessment (PVA) scale based on clover content, response to excreta, species composition, and colour & vigour. Collectively, these four factors reflect aspects of the under-lying soil fertility.

A pasture rating of 9-10 indicates that the soil fertility is such that the pasture production is optimal for a given set of climatic conditions (PVA 9-10/10). A rating of 1-2 suggests that pasture production could be doubled if the soil fertility was optimized.

Pastures with a Pasture Visual Assessment (PVA) of 1-2

Pastures with a Pasture Visual Assessment (PVA) of 9-10.

The theoretical background to the PVA system is set out in a booklet form, together with a series of photographs which a farmer can match against his/her own pastures to determine their PVAs. If they are below 9-10 then soil and clover-only samples should be collected to determine which nutrient or nutrients are limiting at clover production.

To get your copy of the PVA booklet go to enquiries@agknowledge.co.nz ($20 plus postage).

FERTILISER COSTS

Fertiliser prices have been jumping around recently so it is time to take stock of the situation.

Normally the two large co-ops (Ravensdown and Ballance) match their prices at least for the generic products. Recently Ballance announced large increases for the key nitrogen products like urea and DAP. However, this time Ravensdown did not follow suit and it appears that Ballance have had to back-track on their pricing.

The table below shows the current (15/2/22) prices for the main generic products.

Product	Cost ($ per tonne ex works)	
	Ballance	Ravensdown
Superphosphate	369	367
Muriate of potash	1000 (granular)[1]	789 (standard) 995 (granular)[1]
Urea	1190	1190
Triple super	1117	935
DAP	1370	1320
Sulphate of ammonia	712	662
Elemental Sulphur	895 (Sulphur gain Pure)	688 (Sulphur 90 granules)

Notes: 1) Granulated to make it compatible with other granulated products e.g. triple super and DAP.

The prices for superphosphate, urea and DAP are comparable across the companies. The cost of triple super, sulphate of ammonia and elemental S from Ballance are above those for Ravensdown, but note that there is a lot of volatility in some of these markets (see Figure 5) and pricings can depend on time of purchase.

On a per nutrient basis superphosphate is the cheapest form of P after taking into account the value of the sulphur at 0.87 cents /kg. Ravensdown DAP and Triple super are cheaper per unit P than from Ballance.

Product	Cost ($/kg P ex works)	
	Ballance	Ravensdown
Superphosphate[1]	3.03	3.01
Triple super	5.87	4.56
DAP[2]	4.52	4.28

Notes: 1) applying an average cost of sulphur at 0.87 cents/kg S, the average price between Ravensdown (0.76) and Balance (0.99).
2) assuming that N costs $2.58/kg N (see below).

Urea is still the cheapest form of N.

Product	Cost ($/kg N ex works)	
	Ballance	Ravensdown
Urea	2.58	2.58
SustaiN	2.70	2.70 (N Protect)
Sulphate of ammonia[1]	2.66	2.20
DAP[2]	4.10	4.10

Notes: 1) Based on S at $0.87/kg
2) Based on P at $3.03/ha

TRENDS IN FERTILIZER PRICES

The trends in the price for superphosphate for the years 2003 to 2022 is show in Figure 4. These prices are not adjusted for inflation. After a major price adjustment around 2008/09, the price of super has remained remarkably stable. This does not appear to be the case for the major fertilisers traded internationally (Figure 5), which show considerable volatility and noting that the patterns are similar for all these fertilisers.

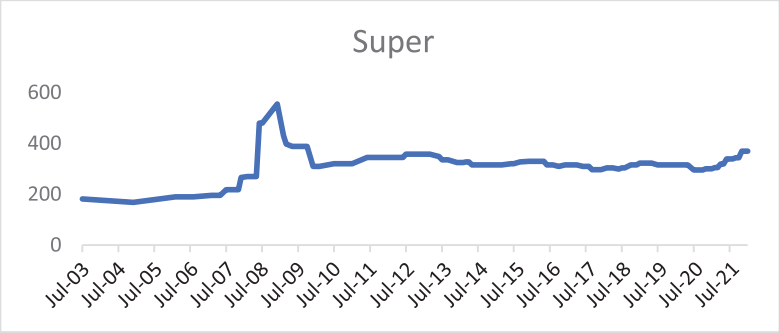


Figure 4 The price of superphosphate over the period 2003 to 2021.

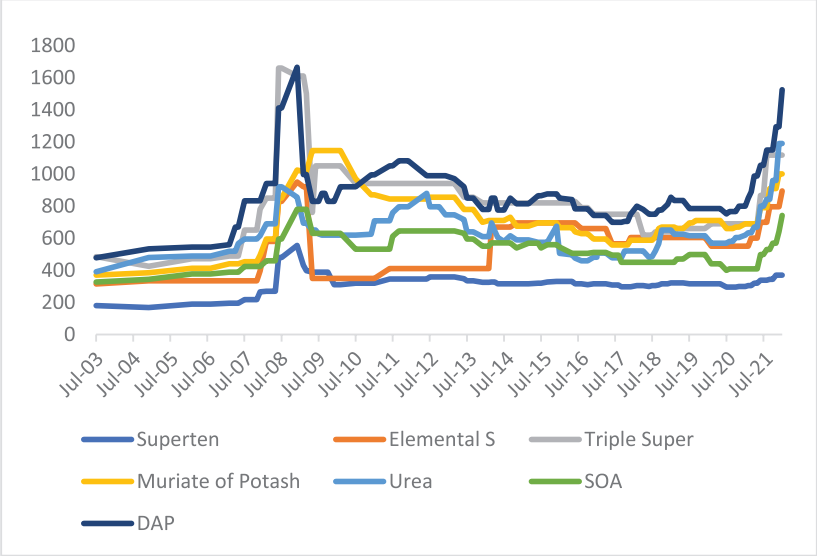


Figure 5 Prices for the major fertiliser traded internationally over the period 2003 to 2021.

TURNING THE SODS

"Turning the Sods," my collection of newspaper columns, is selling steadily, and I must say I am delighted with the feedback. If you have not ordered your copy it is time to act. So while you are at enquiries@agknowledge.co.nz ask for a copy ($35 plus postage) together with a copy of my new booklet "Pasture Visual Assessment" ($20 plus postage).