Optimising pasture quality and quantity using fertiliser

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Introduction

The success of the New Zealand pastoral system is based on a well balanced grass/legume sward. Our climate enables clover to efficiently fix nitrogen, this nitrogen in turn is cycled to grasses by way of animal dung and urine and the decay of plant roots and leaf matter. To maintain a well balanced grass/legume pasture we need to apply the appropriate maintenance fertilisers. Clovers in particular require phosphate and sulphur which is why Superphosphate is traditionally the mainstay of the NZ fertiliser industry.

Our fertiliser advisory staff are well versed in making recommendations as to fertiliser use. They have access to models such as the Agresearch PKS Lime model (formerly the Outlook programme) to assist them in making these decisions. The use of such models and recommendations is covered in the paper by Grey Smith in these Proceedings. This paper will discuss issues such as the different fertility requirements for different farm crop and pastoral systems, some of the different types of fertilisers available, and the use of strategic fertiliser for seasonal growth. Comparisons will be made between a straight deer operation and running deer as part of a sheep/beef enterprise.

Optimum Fertility

The optimum fertility for a deer farm can generally be based on the same principles that apply to sheep/beef and dairy farms, that is, fertility should reflect the level of production anticipated from a farm or on a particular part of the farm. Specific fertiliser requirements will also vary with the specific soil type and the stock type due to soil reserves, phosphate retention, drainage and animal loss factors and these issues are covered by Paul Gregg and Grey Smith elsewhere in these Proceedings. However, in terms of production potential a flatland deer property with one general soil type, is likely to have one optimum fertility level, whereas a rolling downs property may have several optimum levels, each one based on the different landscape units on the farm. The following table (Table 1) reflects this.

Table 1: Generalised optimum soil tests for pasture

	pH	Ca	P	K	S	Mg
Hard Hill		4	10	3	6	5
Easy Hill		4	12	3	6	5
Downs/terraces	5 6-6 0	5	15	5	6-8	8
Fans/moist flats	5 7-6 2	6	15-20	5-6	8-10	10
Intensive/irrigated flats - sheep/beef/deer	5 7-6 3	8	20-30	6-8	10-12	15-20
- dairy	5 8-6 3	8	30-40	7-10	10-12	20-25

At one extreme we have hard hill country which is lowly stocked (<2.5su/ha) and where most growth occurs in spring and early summer the only times soil moisture and temperature are

conducive to optimal growth. Hence annual demands on soil fertility are not high. Conversely in very intensively stocked situations (> 20-25su/ha) where seasonal demands for feed are very critical we need to maintain a higher base fertility and apply much higher and often more specialised fertiliser inputs.

When we also consider that fertiliser is invariably the largest item of discretionary expenditure a farmer faces, and hence the first to be cut in periods of economic decline, it is important to realise a great deal of prioritising of the fertiliser dollar and product substitution already exists.

Fertiliser Options and productivity

The following examples demonstrate the variability and flexibility required in making fertiliser recommendations in different farm types.

Example 1 On a high country property it is not economic to apply fertiliser annually, often the hill blocks are topdressed once every 3-4yrs, hence the more concentrated sulphur supers are used (eg. Sulphur Super Extra 0-7-0-28) to provide residual elemental sulphur to extend the period of clover growth. This farmer recognises the folly of not topdressing the hay paddocks and higher stocked flats because of their importance to the whole operation, hence they may use traditional fertilisers such as Super or potash supers on an annual basis to meet these demands. Intermediate areas may get a lower sulphur content Sulphur Super (0-8-0-19) on an annual or biennial basis.

Example 2. A very intensive property is applying fertiliser at least once a year. Ideally this should be split further as this allows the farmer to mix and match different fertilisers to provide several nutrients at one dressing and other nutrients in a second dressing. A dairy farmer may choose a DAP based fertiliser (or nitrogen plus Super) to boost early season growth followed up in late spring with potassic supers. Nitrogen dressings to strategic parts of the farm will also be used when projected feed deficits are identified.

Where does a deer farm fit in?

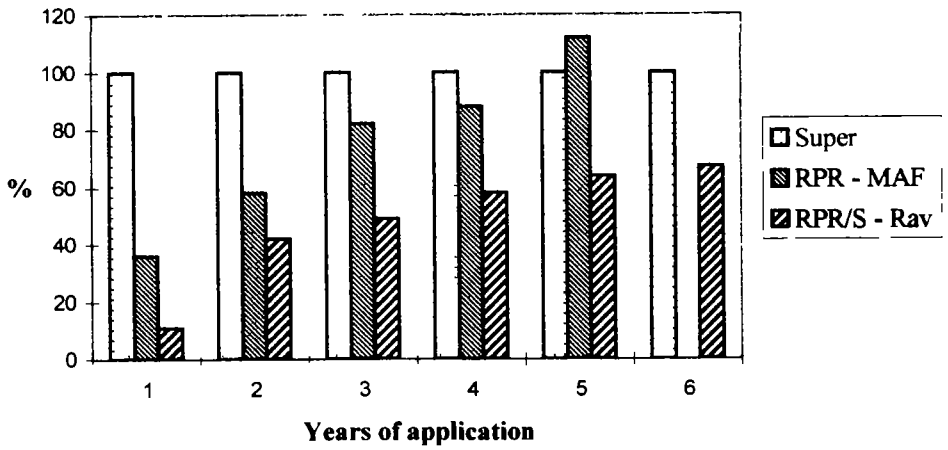
The handling of the pasture growth pattern poses the main difference between deer farmers and sheep and cattle farmers. Two issues immediately stand out, how to maintain quality of pasture at calving in early summer and how to maintain a quantity of quality feed through the summer. Compounding this will be the geographical location and topography of the property (when does spring growth commence), and the proneness of the farm to summer moisture deficits. The data of Barry et al., 1998b would suggest 10cm is the ideal grazing height for deer pasture. This means spring growth has to be controlled, either by sheep or cattle grazing, perhaps another class of deer or the early making of supplements. Obviously integrating grazing by sheep and cattle has a lot of merit at this time of year but this does not suit all deer farms, as may not the grazing of other deer classes. Also with spring growth being too lush and underfoot conditions often too wet for machinery there is a limit to how early you can make supplements. Topping of pasture is essential in early summer to maintain quality. Soil fertility wise the following work may be of significance to deer farming.

Phosphorus

Form of Phosphorus - Two major studies have been carried out in New Zealand on the effects of different P sources on pasture growth. The MAF 'National Series' where P forms were trialled in the presence of adequate sulphur and the Ravensdown Forms of P and S trials (Fig 1.) where commercial fertilisers containing different forms of P were compared. The data shows that the effectiveness of reactive phosphate rock (RPR) is best under warm moist

conditions of lower pH (< 5.8-6.0). The Ravensdown data in particular highlights that it is summer rather than annual rainfall that drives this. Super (ie soluble P) gave the highest production on summer dry soils in November/December as the soil was drying out. It was not uncommon for soluble P treatments to contain more white clover than control or slow release P treatments (which usually contained little white clover or more suckling clover).

Fig. 1. Dry Matter performance of RPR or RPR/S as a percentage of Super



RPR - MAF report 'National Series' forms of phosphate fertiliser trials. Part 1 Smith et al , 1990
RPR/S - Ravensdown internal report - Forms of phosphate and sulphur pastoral trials Craighead 1997

Maintaining higher P fertility - This issue is constantly raised by intensive farmers, in particularly dairy farmers. Two studies are underway, - the first is at Westpactrust Agricultural Research Station, Taranaki on ash soils. In its third year of production maintaining Olsen P fertility > 30 has increased milk solids production. Much of this gain is in growing more grass and utilising this by having more cows in milk for longer (DRC Feb 1998, July 1998). Our work at Seadown, South Canterbury on sedimentary soils shows that maintaining an Olsen P of at least 30 has in the 15mths to date increased pasture production and beef cattle grazing days.

Soil moisture - data derived from Ballantrae by Sakadaver (joint Agresearch, FLRC data) suggests that maintaining P > 30, S >12 helped utilise water more efficiently (350L to grow 1kg grass) than a site where P = 14, S = 7 (where 830L of water is required). This has implications to deer farming with summer dependancy on feed.

Specialist crop demands and out of season feed

Fertiliser demand for crops depends on whether the crop is legume or non legume based. Specialist crops include specialist grass species, annual or hybrid ryegrasses, brassicas, chicory and lucerne or red clover.

Where the paddock is a specialist perennial grass, eg. fescue, these crops may not have much legume base and therefore require regular nitrogen inputs as well as maintenance phosphorus

and sulphur. High quality chicory stands, or pasture containing clover and chicory (Barry et al 1998a, 1998b) are best treated as 'normal' pasture, ie maintained with phosphorus, potassium and sulphur. Additionally they will require nitrogen, the amount depending on the contribution by clover to the stand or sward. Chicory does have the benefit due to its deep rooting nature in being able to forage for nutrients (such as magnesium and zinc) and water. However questions still remain as to its persistance, particularly in a pasture sward (eg. Barry et al., 1998b), and its winter dormancy.

Where specialist crops are grown on an annual basis the need for nitrogen is dependent on the paddock history. Crops grown ex good pasture will mineralise nitrogen in the short to medium term, the rate depending on how early and well the paddock is worked, and the climatic conditions. Conversely crops grown ex run out (ie. browntop dominant) pasture, or previous crop will have lower reserves of nitrogen. Runout pasture can be a sink for nitrogen in the first 3-9mths after renovation. These crops not only require starter nitrogen (eg. Cropmaster products) but sidedressing of nitrogen as well. It requires experience and knowledge of local climatic conditions to apply sufficient to maximise growth while minimising the risk of high nitrate situations. Fertiliser application method at planting is also critical relative to seed germination of brassicas and other small seeds. Further issues with brassicas involve the use of sulphur in relation to SMCOs and animal feed intake and phosphorus in terms of growth. Brassicas have a much higher demand for phosphate than pasture with minimum inputs of 20kgP/ha and often optimal inputs of 40-50kgP/ha.

Annual and hybrid ryegrasses are a very valuable and nutritious source of out of season feed. They can either be used in conjunction with brassicas, as part of a pasture mix, or as a specialist crop in their own right. We have used annual ryegrasses successfully in winter to graze cattle (Craighead et al., 1998) under a well managed grazing regime (Table 2). A modified version of this could suit deer as with continuous winter growth good cover and feed quality can be maintained as opposed to the poorer set stocking regime mentioned by Barry et al., 1998b. Many newer generation hybrid grasses have 2-3yr persistance and can continually achieve high dry matter production with good grazing management, provided good phosphorus, sulphur and high nitrogen inputs are maintained.

Table 2. Summary of winter beef performance on Italian grass seed crops Ravendown Fertiliser Seadown Farm 1994-1996

	1994	1995	1996
Days Grazed - start of April to early Oct	182	183	182
Initial Liveweight (kg)	260	270	265
Final Liveweight (kg)	423	437	447
Liveweight Gain	163	167	182
Liveweight Gain/day	0 9	0 9	1 0
Stocking Rate (steers/ha)	3 4	3 5	3 6
Liveweight Production (kg/ha)	570	605	665
Nitrogen Used *	140	160	152
Estimated kg DM (end of Jan - early Oct)	>10,500	>9,500	>10,000
Supplementary Roughage	minimal	daily	daily

* 40-80kg of this N would normally be used in autumn to establish the grass seed crop

The use of legumes as specialist crops has been around for many years. These have the advantage of high feed quality and little nitrogen input (except at establishment). Deep or well

developed rooting legumes (lucerne, red clover, caucasian clover) do require good phosphorus and sulphur inputs. Their demand for potassium is much greater than that of grasses. boron needs to be regularly applied in dryland situations and they are much more sensitive to soil pH. Accordingly molybdenum is usually required at some stage in their growth. As clovers respond well to temperature their seasonal growth curve ties in better than pasture with deer calving but with the disadvantage of poor winter and delayed spring growth for other animal classes.

Clover balance in pasture

Ideally pasture should contain a grass to clover ratio of 70 to 30. However, in reality this only occurs for a short time of the year, particularly where soil moisture is limiting. The conundrum that exists with deer pasture management is that if deer prefer grazing less intensively, then the longer pasture is allowed to grow the more the grass shades out the clover and the less successfully the clover competes. There is also concern that high fertiliser nitrogen inputs will reduce the clover content of pasture, although the evidence for this is conflicting and depends on pasture management. Recent evidence by the Dairy Research Corporation staff presented at the 1998 New Zealand Grasslands Association conference, shows that milk production is increased at higher proportions of clover in the pasture.

Use of Nitrogen on Pasture

It is now an accepted practice to use fertiliser nitrogen to boost out of season growth on pasture. However, the responses to nitrogen can be erratic particularly if there is uncertainty in climatic conditions. Typical responses have previously been documented (eg. O'Connor, 1982) as 2-13kgDM/kgN applied for autumn applications to 6-19kgDM/kgN for spring applications (when 25kgN applied), although new pasture species have the ability to respond much better. Ideally soil temperature should be >6-8^{o}C although some good responses can occur at lower temperatures, 3-5^{o}C, especially with annual ryegrasses. We have achieved 15-30kgDM at these temperatures (Craighead et al., 1997). Ideally nitrogen should be applied at low rates 20-30kgN/ha to pasture, 30-50kgN/ha for supplementary feeds, well in advance of feed deficits (4-6wks for pasture, 6-8wks hay/silage), to well maintained pasture with some pasture cover. Only apply nitrogen to that area you can manage, and in conditions of dry weather or long overcast days delay topdressing and/or reduce application rates to reduce the risk of nitrate poisoning. The choice of nitrogen sources is quite diverse, eg. DAP, ammonium sulphate, calcium ammonium nitrate, each has its merits at different occasions. However currently economics heavily favour urea.

Sulphur, Molybdenum, Cobalt

The importance of sulphur to clover production on hill and high country sedimentary soils cannot be emphasised. In these environments possibly 80% of pasture production can be driven by sulphur. This is demonstrated by some of our early work in the Mackenzie country (Craighead et al., 1990) where large responses were obtained to Sulphur Super Extra (0-7-0-28), mainly a response to clover adequacy. In turn, available nitrogen in the soil was increased. Molybdenum is also widely used in these environments as soil levels are usually low so they should not impact on copper metabolism, but out of safety these should be ascertained through clover samples before molybdenum is widely used. The link between sulphur and copper remains tenuous, and if indeed there is a link it is more than offset by the dry matter production sulphur can provide. It is important to note that clover contains higher cobalt concentrations than grass so a well maintained sward can alleviate cobalt issues in stock on all but deficient soils.

Summary

The optimum fertility for a deer farm is based on the production objectives and potential of the farm as it is with any other farming operation. Where deer farming differs is in the handling of the seasonal feed requirements and hence fertilisers may alter to suit strategic pasture growth within climatic constraints, and the needs of specialist crops.

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