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MANAGING SOILS FOR BETTER PASTURES:

BEST BET FERTILISER STRATEGIES - PART 2

Graham J. Crocker

Senior Research Agronomist,
NSW Agriculture,
TAMWORTH NSW 2340

Abstract: *Use of appropriate fertilisers is one of the best and quickest ways to increase pasture quantity and quality. Fertiliser is one of the major annual costs of animal production, so it is important to obtain the greatest return from capital spent. This paper examines what to look for when choosing a fertiliser from the large range that now exists and discusses the best strategies for fertiliser use with limited resources. It also briefly discusses gypsum and elemental sulphur and the use of gypsum for improving soil structural stability.*

INTRODUCTION

In the past, fertilising pastures involved a relatively easy choice between 4 fertilisers. Today with increased competition and improved technology, there is an expanded range of products.

Pasture fertilisers can be placed in 3 main groups: (1) those high in phosphorus (P) and low in sulphur (S) for soils deficient in P but with adequate S; (2) those containing a balance of P and S which suit the majority of soils; (3)and fertilisers low in P and high in S for soils requiring S such as basaltic soils with a high phosphorus level.

CRITERIA FOR SELECTING FERTILISER

There are five important criteria that need to be considered when selecting a fertiliser:-

Soil Tests

These are important for determining present soil fertility status and indicating the likelihood of response and how much nutrient to apply. Reliable soil tests are available for phosphorus and potassium and a test for sulphur may be available shortly. Soil pH gives a measure of soil acidity and the possibility of response to trace elements, especially molybdenum, which have no reliable soil test (Blair , 1992; in these proceedings).

Nutrient Content

This determines the rate at which the fertiliser is applied and also price per unit of nutrient. More highly concentrated fertilisers mean that you buy and transport less product. However, such products may incur a surcharge in spreading costs.

Nutrient Availability

A high nutrient content of a fertiliser does not guarantee that the nutrient is available to the plant. Rock phosphate, for example, can contain 16% P, but be virtually unavailable to plants in neutral to alkaline soils. Elemental sulphur is not readily available to plants, but does become available as long as the particle size is fine (<500 micron, Weir *et al.*, 1963). Gypsum too can be less than fully available if particle size is large.

Cost

Basic cost in $/tonne is no criteria to determine your fertiliser purchase as you have to consider the nutrient content and divide the price by 10 times the percent concentration. This is because if a product contains 8% P, 1 tonne (1000 kg) will contain 80 kg P. This then allows you to compare all products on a per unit of nutrient basis.

When a product contains more than one nutrient, the calculation of cost becomes more difficult. If you are comparing the cost of a product containing both phosphorus (P) and sulphur (S). Calculate the cheapest form of P, say from triple super, which may be $2/unit of P. If your product contains 8% P and 15% S then multiply $2 x 80 to give $160 which is the price of the P in the product. Then subtract this from the total price and divide by S content.

eg. $300 - 160 = $140

150 kg S = $0.93 /kg S

Remember it is always easier to calculate the cost of a tonne of fertiliser "on the ground" as this takes into account transport and spreading charges which can vary considerably depending on nutrient content which determines the rate applied and hence total quantity required.

Ease of Handling

These days most products are granulated or pelleted and flow very well, but some flow better than others. Elemental sulphur can be explosive when spreading from aircraft, but it too, is now pelleted and can be safely spread. By- product gypsum can be difficult to spread if wet unless the right equipment is available.

STRATEGIES ASSUMING LIMITED RESOURCES

When it is not possible to fertilise the whole property, what are the priorities for determining the optimum benefits of your fertiliser dollar? Again start off with soil testing which will indicate whether to fertilise or not and identify which paddocks to start with. Other factors should also be considered including:

New Pasture

Fertilise new pasture sowings on P deficient soils as first priority because of the costs involved in establishing it. For a saving of a topdressing cost of $30/ha you may have to resow the pasture at 5 times that cost. Similarly, recently sown pastures on P deficient soils are a high priority.

Greatest Potential

Select paddocks that have a low P soil level, that are dominated by high potential improved species, especially well adapted legumes. These will usually give the largest response to fertiliser and therefore the best return on money invested.

Longest Absence

If the property has been fertilised in the past, topdress areas that have not received fertiliser for the longest time, assuming responsive legumes are present.

Follow-up

In situations where a fertiliser program has only just begun, it is best to continue to concentrate on one area and bring the production up to its potential. Research on the northern slopes of NSW, where little or no fertiliser had been previously applied, showed that follow-up applications of fertiliser greatly increased yields compared to a single initial application (Table 1).

These results were achieved comparing 10 kg of phosphorus in the first year only, with 10 kg of P and 25 kg S applied yearly for four years and comparing pasture production each year. By the fourth year, production from the once only fertilised area was only 25% of what could have been achieved from annual applications. Even though it had received four times as much fertiliser, the extra production would be economic. This is further emphasised by the fact that in spring, the production was increased 10 fold and the quality of pasture was also markedly increased (Crocker, 1992).

In areas that have had a long fertiliser history, the drop in production will not be as marked and results from the northern tablelands showed that after applications of over 350 kg phosphorus (4 tonne superphosphate/ha), liveweight and wool production were maintained for about 10 years before pasture and livestock production started to decline.

The difference in the two systems has been the preceding fertiliser amount, nil versus high application rates and the pasture species present. The pasture species grown in the slopes region consisted of mainly shallow rooted annuals, such as subterranean clover, while the tableland pastures consisted of phalaris and white clover, which are deeper rooted perennials and hence were able to recycle more of the applied nutrients. Where topdressing is withheld for lengthy periods, a close check should be kept on changes in pasture composition, particularly the legume content.

Table 1: Average reduction (%) in yield after missing 1, 2 or 3 fertiliser applications compared to annual fertiliser applications.

Parameter	Missing Annual Fertiliser Applications for: 1 Year	2 Years	3 Years
% yield reduction	45	52	75
Range over all sites	6-97	6-93	60-96
No. of sites	18	12	5

Maintenance

Because of the increased quantity and quality of production from fertilised improved pastures, it is important to maintain special purpose pastures for fattening, joining, lambing or hay cutting.

Efficiency

It is generally better to apply around 10 kg P/ha over a small area than 2-3 kg P/ha over 3 to 5 times the area when P levels are well below critical levels. With products giving longer residual effects, such as those containing Reactive Phosphate Rock (RPR) and elemental sulphur, it is possible to split the property into 2 or 3 areas and apply fertiliser to these every second or third year.

Other Deficiencies

Production is always determined by the most limiting factor. In some cases, this will be water but for nutrients, one particular nutrient will not substitute for another. For example, if phosphorus is limiting plant growth, no amount of sulphur will correct that deficiency. This also applies to other elements including trace element such as molybdenum, boron, zinc or copper. While trace element deficiencies (except molybdenum) are uncommon, your district adviser should be consulted if a deficiency is suspected. In the case of nitrogen, encourage the pasture legumes to supply nitrogen for the system.

Legume Base

It is essential that the pasture contain legumes as these are the first to respond to applied fertiliser. This is especially important in native grassland as the native grasses are generally adapted to low fertility conditions. However, while there may be little evidence of production response to fertiliser, there may be some increase in plant nutrient content and hence palatability. *Danthonia* is one native genus with species that do give some response to fertiliser, but since all grasses require nitrogen, legumes are necessary to provide a cheap nitrogen supply. If legumes are not present, then introduce them with initial fertiliser applications.

Quality

Fertilisers increase pasture production and pasture quality. This includes P and S plant content and especially protein and digestibility. In native grass pastures, the legume content can increase from less than 5% to 60% which lifts the protein content significantly. In trials, protein increases from 8 to 20% and digestibility increases from 55 to 75%, have been measured.

Utilisation

To make the application of fertiliser profitable, you must be able to utilise the extra production, so it will be necessary to increase your stocking rate. Although increased production and ground cover may help build up organic matter and reduce erosion, it is the increase in animal production that generates profits.

Timing

While yearly production is generally similar from different time of application, the distribution is different with a boost in production after application which tapers off towards the end of 12 months. The preferred application time is in late summer-autumn as this coincides with germination of annual legumes. It is also the time when an increase in pasture production allows a carry-over into winter, a time of pasture shortage (Cregan *et al.*, 1989). On soils that are prone to waterlogging in winter, late spring/early summer applications of fertiliser can be more effective.

Placement

If you have a choice, it is more effective to put the fertiliser in the soil rather than on the surface (Rudd and Barrow, 1973). Fertiliser is about twice as effective when incorporated because P is not very mobile in the soil and so roots have to be close to the surface to absorb fertiliser applied to the soil surface. This is also the zone that dries out most rapidly and allows greater opportunities for P fixation. However, except in the year of establishment, topdressing is the only option available when fertilising established pastures.

GYPSUM AND ELEMENTAL SULPHUR

There are two main forms of S fertiliser: (1) gypsum ($CaSO_4$); and (2) elemental sulphur. Gypsum is a by-product of superphosphate manufacture and comes in white to grey fine crystals which can be wet and difficult to spread unless it is dried. It is also mined in arid areas and this crystalline product is easier to spread. Gypsum is a soluble product which provides readily available sulphur, but it has a low S content (12-18%) and low residual effect (less than 12 months), because of leaching.

Elemental sulphur is a yellow product that is not immediately available to the plant but has to be converted by soil bacteria to the sulphate form (Duncan, 1991). This requires the product to be finely ground, the presence of bacteria, adequate water, aeration and temperature for this process to occur. The advantages of elemental sulphur are that it has a high S content (60-99%) and gives a good residual effect (2 to 5 years depending on fineness, rainfall and rate of application).

Another use of gypsum is to improve soil structure. For this purpose, different rates are needed. When used as a S fertiliser, gypsum is applied at 60-150 kg/ha, supplying 9 to 20 kg S/ha, while for soil amelioration it needs to be applied at 2.5 to 5 t/ha (Abbott & McKenzie, 1986). Higher rates can be used but are generally uneconomic. Gypsum is applied at these high rates to replace the sodium on the clay with calcium which stops clay dispersion and so improves soil structure. Soil structure is the arrangement of sand, silt and clay particles in the soil to form aggregates. The maintenance of these stable aggregates allows better water and air infiltration and better germination of seedlings.

Gypsum is used to supply calcium rather than lime as the calcium is more readily available, is easily handled and can be used on soils of all pH's. However, gypsum will not correct traffic compaction pans or soil acidity.

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