INCREASING PRODUCTION WITH PHOSPHORUS AND SULPHUR - NORTHERN SLOPES

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Trials were started in 1987 to examine the effect of phosphorus and sulphur on pastures in the Tamworth, Manilla, Barraba and Bingara areas, representing the northern slopes of New South Wales. The pastures at nine trial sites consisted of native grasses, mainly red grass (*Bothriochloa* sp.) blue grass (*Dicanthium* spp.), lovegrass (*Eragrostis* spp.), wallaby grass (*Danthonia* spp.) and naturalised bromes (*Bromus* spp.), into which subterranean clover had been broadcast. A further six sites contained sown pasture consisting of red, white and subclover, lucerne, phalaris, cocksfoot and ryegrass in varying combinations.

The northern slopes were chosen because pasture research has been neglected there in contrast with the tablelands where much work has been encouraged because of the better environment for pasture production. Mixed farms predominate on the slopes and more recently the emphasis has changed in response to greater returns from livestock and less favourable returns from cropping. As a consequence, country that was fertilized only during the cropping phase is now receiving more attention, as landholders recognize the potential for increased production from better pasture management.

The trials were put down to examine the response to phosphorus and to check if sulphur was limiting growth. Twelve of the sites responded to sulphur while nine gave significant responses to phosphorus. In most cases the response to sulphur was greater than the response to phosphorus. These results are associated with the lack of fertilizer application in the past. The three trials that gave no response to sulphur were all on sown pasture that had been cultivated and fertilized.

CAUSES OF SULPHUR DEFICIENCY

Sulphur deficiency is more commonly associated with heavier soils, high pH, rainfall and altitude. Continual cultivation leads to a breakdown and depletion of soil organic matter which the CSIRO and University of New England have found can supply 80% of plant sulphur needs. Sulphur removal in plant and animal products can also lead to a depletion of sulphur reserves. One kg of sulphur is removed by 1/2 tonne of wheat or legume hay, 3/4 tonne of cereal hay, 150kg rapeseed, 125kg meat or 25kg wool.

FORMS OF SULPHUR

Sulphur can be applied as calcium sulphate (gypsum) which is soluble and therefore readily available, or as elemental sulphur (flowers of sulphur or brimstone). Elemental sulphur is not soluble and so is not immediately available for plant uptake. It must first undergo oxidation by *Thiobacillus* bacteria to convert it to sulphate. This process is dependent on the number of bacteria, the fineness of the sulphur particles, on temperature, aeration and rainfall.

Superphosphate, gypsum and most compound fertilizers contain sulphur in the readily available sulphate form. When higher sulphur content is required than these fertilizers supply, elemental sulphur is added. Thus sulphur-fortified superphosphate (SF45) contains some readily available sulphur in the sulphate form and some elemental sulphur which, not being subject to leaching, increases the residual effect.

DETERMINING SULPHUR REQUIREMENTS

Sulphur requirements can be determined by soil or tissue tests, fertilizer strips or trials. Soil tests are not a reliable guide because they measure the sulphate form which fluctuates widely due to the rate of release from organic matter, and they are usually based on samples taken only to 10 cms. There can often be an accumulation of sulphur below this depth that plants can use. Tissue tests can be a useful guide but critical levels can vary depending on the plant part sampled and the development stage at sampling.

Test strips are the most practical for farmers to use, but need to be left for 6-8 weeks with livestock excluded. To promote a visual response, sulphur should be applied at 15-30kg S/ha in autumn or spring when pasture is actively growing.

Although the trials on the northern slopes looked at only one rate of sulphur, 25 kg/ha/year, we can get some information on sulphur rates.

Table 1. **Effect of applied phosphorus and sulphur on pasture dry matter yields - kg/ha**

Nutrients kg/ha P	Nutrients kg/ha S	Site 1	Site 2	Site 3
0	0	600	1025	800
0	50	3050	3575	1150
10	12	3575	2925	1700
10	50	4025	3425	1875
80	8	2275	3300	2350
80	58	5140	4775	3830
Significant differences		687	739	722

An application of 8kg S/ha is not adequate as yields are increased markedly by additional sulphur when phosphorus is not limiting. However, at lower rates of phosphorus, yields were not increased as dramatically with extra sulphur, which indicates that at these 3 sites both phosphorus and sulphur were deficient, so that the higher yields were not obtained unless both nutrients were applied.

These results indicate that on newly established pastures on the northern slopes there is a need for at least 12kg S/ha. The requirement for phosphorus will vary from nil to 20kg P/ha and this can be more accurately determined from soil tests. Where phosphorus and sulphur are required at the beginning of a fertilizer programme, it is most often appropriate to use a fertilizer with a P:S ratio of approximately 1:1.

McLaughlin and Holford (1982) found 20kg S/ha, either as gypsum or part gypsum, gave maximum yields in the first year, with subsequent applications of 10kg S/ha to maintain maximum yields from a white clover pasture over three years. Also on a basaltic soil, but in southern New South Wales, McLachlin and DeMarco (1973) found gypsum at 34kg S/ha was required for maximum production in the first year and 8kg S/ha in subsequent years.

EFFECT OF SULPHUR

While all plants require sulphur, legumes have a higher requirement than grasses and are the best indicators of sulphur deficiency.

Table 2. Legumes as a percent of total dry matter yield - spring 1987

Nutrients kg/ha		Site 1	Site 2	Site 3
P	S			
0	0	13	6	13
0	25	18	9	57
20	25	28	20	85

It can be seen that sulphur and phosphorus increase the legume component of the pasture (Table 2) which, in turn improves the quality of the pasture by increasing the percentages of phosphorus, protein and sulphur (Table 3).

Table 3. Plant chemical composition in spring, 1987 - % weight in the dry matter

Nutrients kg/ha		Site 1			Site 2			Site 3		
P	S	P	Protein	S	P	Protein	S	P	Protein	S
0	0	0.28	11.9	0.316	0.27	10.0	0.236	0.31	14.5	0.30
0	25	0.29	13.1	0.365	0.29	10.8	0.300	0.30	21.0	0.40
20	25	0.34	14.9	0.381	0.29	12.4	0.355	0.35	22.5	0.35

[Harvest dates:- Site 1 - 10/4/87; Site 2 - 29/10/87; Site 3 - 17/9/87]

Responses in summer, to fertilizer applied at the end of autumn, were much smaller than in spring and late autumn. So the timing of fertilizer application should be aimed to coincide with periods of legume growth and more favourable climatic conditions.

REFERENCES

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