INCREASING PRODUCTION USING PHOSPHORUS AND SULPHUR

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SUMMARY

Fertilizer application increased pasture productivity by between 60 and 500 % in a series of experiments conducted over an extensive area extending from Gwabegar, Baradine, Bugaldie, Coonabarabran, Binnaway, Baradine and Tambar Springs to Coolah. In each trial there was a major response to sulphur and, in several, also to phosphorus. The response to phosphorus was consistent with the predictions from soil tests.

All but two trials were conducted on previously unfertilized non-arable or permanent arable pastures. The two trials on paddocks with a long fertiliser history but no applications for four or five seasons, showed a big response to sulphur.

INTRODUCTION

Research over many years has shown phosphorus and sulphur are deficient in the northern, central and southern tableland districts. Research has also shown the role of superphosphate in several parts of the south west slopes and in the southern part of the central west.

However fertiliser research has been less intensive in most of the northern slopes and plains and the upper central western slopes. Prior to 1983, less than five percent of properties in the Coonabarabran district applied fertilizer to pastures. Coolah, at the south eastern end of the district, had a long history of fertilizer usage but other areas such as Baradine, Gwabegar, Purlewaugh, Binnaway and Mendooran had very little history. Pasture research programmes had never properly addressed the sulphur/phosphorus interaction or measured likely responses to fertilizer.

A series of trials conducted in the Coonabarabran district has attempted to examine the response to sulphur and phosphorus on pasture country previously not fertilized, and also to look at likely responses on paddocks subjected to a long history of fertilizer use.

TRIAL PROGRAMME

Series 1: In 1983 fertilizer trials comparing SF45 at three rates (0,100 and 200 kg/ha) commenced in high phosphate soils at Goolhi (Mullaley area), Coonabarabran, Tambar Springs and Coolah. These trials consisted of plots 10m x 10m, treatments were replicated three times and the trials were fenced off for observation and field days.

All, except the Coolah trial, were on country previously not fertilized. The Coolah site had had a history of sulphur (gypsum and SF45) and some phosphorus (SF45) application since the mid 1950s. However, no fertilizer had been applied for the past four seasons.

Dry matter was measured at the Coolah trial in the spring of 1983 (fertilizer was applied in the autumn). SF45 at 100kg/ha resulted in a 30% increase in dry matter. Plant analysis during mid winter indicated sulphur was below optimal levels in the nil plots but adequate in the fertilized plots. The 200 kg/ha rate was no better than the 100 kg/ha rate.

The other trials were used extensively for field days but no dry matter yields were taken. Visually, SF45 increased production by several hundred percent. SF45 at 100 kg/ha appeared to produce similar results to the 200 kg/ha rate.

Series 2: This series of trials, although extremely valuable for extension purposes, failed to sort out the sulphur/phosphorus interaction. The trials were continued for three years without a follow up application.

Two trials were established at Ulamambri and Binnaway in 1987 comparing three rates of single super (0, 100, 200 kg/ha), and three rates of SF45 (0, 100, 200 kg/ha). The Ulamambri trial was a non arable hard setting red soil with moderate phosphate levels. The Binnaway site was a sandy loam growing a 10 year old subclover pasture and testing low in phosphate. Both had no previous topdressing history. Again the trials consisted of plots 10m x 10m, with three replications, and were fenced.

The fertilizer responses were again large, but the trials did not determine how much of the response was due to phosphorus and how much was due to sulphur. The Binnaway site measured in the spring of 1987 and 1988 showed a six fold increase in productivity from single super application (following autumn application). The Ulamambri site was only measured in spring 1988 and showed a similar response. The response from single super was superior to the response from SF45 at Binnaway, suggesting the need for adequate phosphorus. The response to SF45 was similar to the response to single super at the higher phosphate Ulamambri site.

Series 3: Four trials were commenced in 1988 to examine, in more detail, the phosphorus/sulphur interaction. These trials were also on permanent pasture, three of them having no previous fertilizer history. The fourth trial was on a paddock with a 25 year history of super application but none for the past five years. Treatments included sulphur only (gypsum), phosphorus only (Trifos), sulphur and a low rate of phosphorus (SF45), sulphur and a moderate rate of phosphorus (single super), and the latter with molybdenum (Mo single super). Trials were at Gwabegar (moderate P, red loam, subclover), Bugaldie (moderate P, hard setting loam, natural clover), Binnaway (low phosphorus, sandy loam, subclover) and Coolah (lucerne, subclover, loam, long history of super except last 5 years). All trials consisted of plots 10m x 10m with three replications and were fenced. Fertilizer and a subclover mixture of Nungarin, Dalkeith and Junee was spread on all plots in late March.

Dry matter measurements taken in the spring, were statistically analysed and found to be significant (except the Bugaldie trial). The results are recorded in Table 1 and the accompanying figures (Fig. 1, 2 and 3).

Averaged over the four trials sulphur (16 kg/ha) increased yield by 80 % (range 46 to 141 %). Phosphorus increased yield by 66 % averaged over the four trials (range seven to 129 %).

Table 1: 1988 Dry matter production at five sites (as a per cent of dry matter produced without fertilizer)

Treatment (kg/ha)	Nutrient applied (kg/ha) P	S	Gwabegar	Bugaldi	Ulamambri	Binnaway	Coolah	MEAN (4 1988 trials)
			SITE					
NIL	0	0	100	100	100	100	100	100
TRIFOS (50)	9	1	138	107	-	279	138	166
GYPSUM (100)	0	16	172	146	-	241	161	180
SF45* (100)	5.5	45*	186	168	527	442	163	240
SINGLE (100)	9	13	221	151	-	458	163	248
Mo SINGLE	9	13	-	197	-	478	149	-
SINGLE ** ('87+'88)	9	13	-	-	603	587	-	-

*SF45; only approximately 33 per cent of sulphur is available in the first year

**Single super at 100 kgs/ha was applied twice in this treatment - autumn 1987 and autumn 1988.

Sulphur and phosphorus combined as SF45 increased yield by an average 240% with the range being 86 to 348 %. While single super performed better than SF45 at the two lower phosphate sites its response was similar to SF45 in the higher phosphate trials. Molybdenum was included at three of the sites and resulted in a small response at two of them.

1989 TRIAL PROGRAMMES

The 1987 and 1988 trials are continuing to be assessed with a run-down of some treatments being measured against nil and single super applied every year (100 kg/ha). Additional trials have been established in 1989. They cover products such as Goldphos, Calphos, Dynamic Lifter, Sludge and Bio-dynamics, which are being compared with nil, single super and SF45.

CONCLUSIONS

1. All trials established between 1983 and 1988 have shown a large and economical response to fertilizer. The response has nearly always been in the order of at least 100 % and commonly up to 500 %.

FIGURE 1

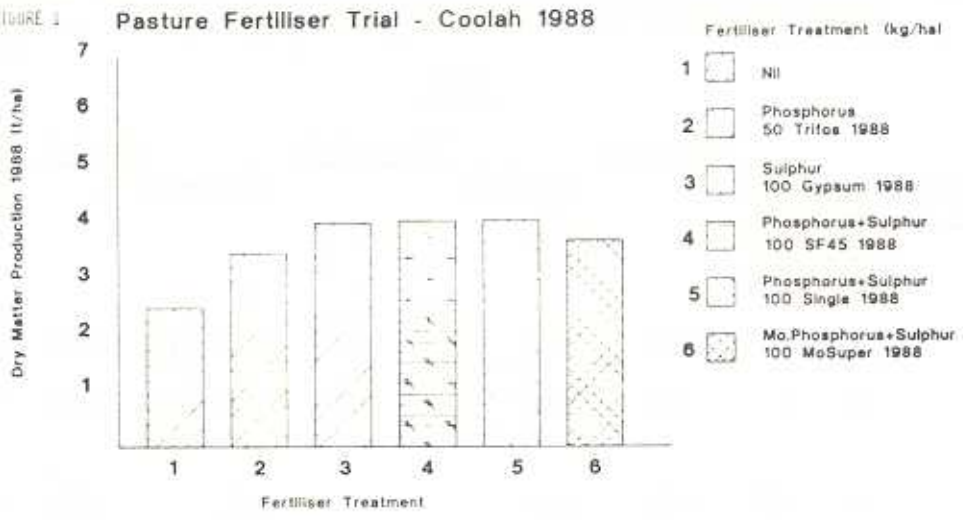


FIGURE 2

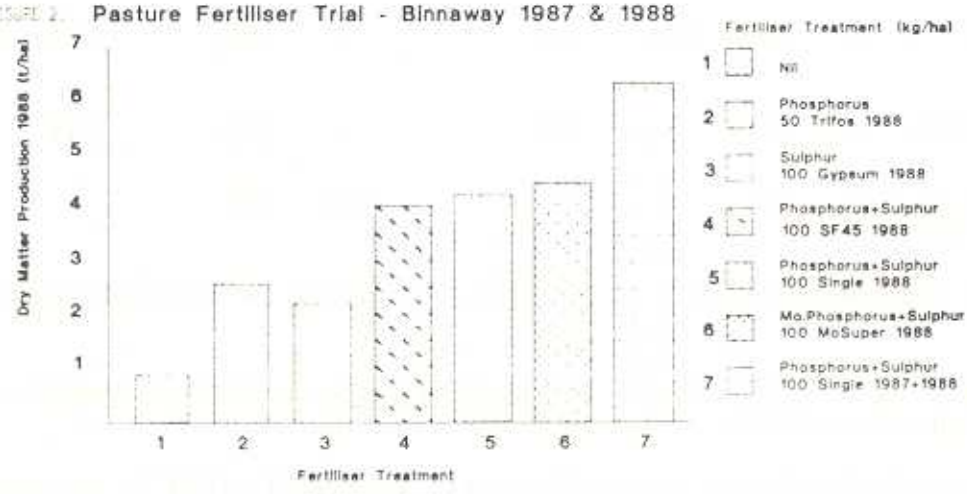
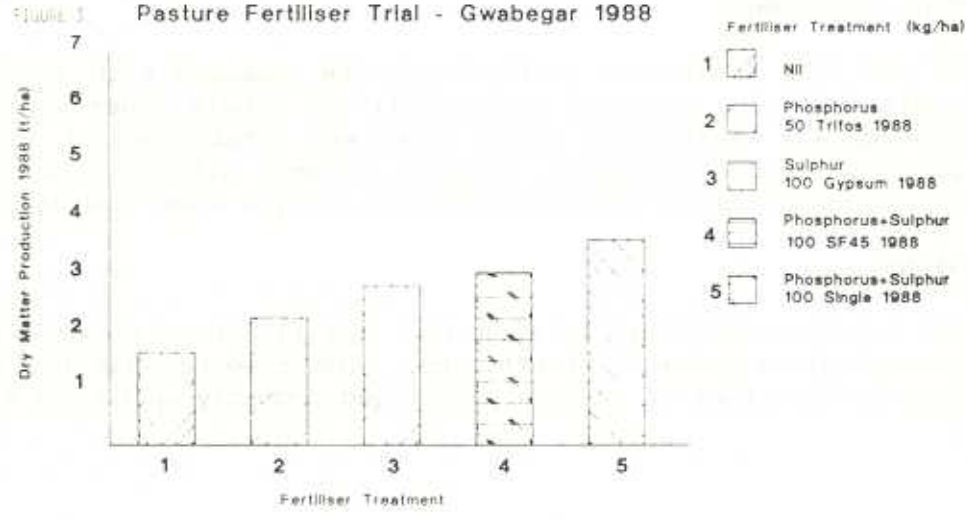


FIGURE 3



2. The 1988 trials suggest that sulphur is universaly deficient in permanent pastures where little topdressing has been practiced or it is some time since fertilizer was applied.

3. Phosphorus responses were generally large where soil tests indicated moderate to low phosphorus levels.

4. Molybdenum applications added marginally to productivity in two out of three trials.

5. The trials mainly aimed to highlight nutrient deficiencies and suggest relatively cheap and feasible fertilizer strategies to correct them. For example our standard superphosphate application is 100 kg/ha, applied every year for the first three years. SF45 at 100 kg/ha is applied every third or fourth year. It is more likely that pastures on low phosphate soils would continue to respond to greater rates of superphosphate. However this represents the possibility of increased loss of nutrients by run-off or leaching (potential pollution problems), and a much more difficult package to sell to the client (farmers). The responses to (and economics of) higher fertilizer rates is an area for future research.

6. After a build-up period, pasture productivity can probably be maintained by rates of sulphur lower than 13 units per hectare per annum.

7. More research is needed to better define actual sulphur and phosphorus requirements. The current trials have identified the deficiencies, the scale of responses likely at relatively modest fertilizer rates and some suggested guidelines for fertilizer programmes.

8. Introduced subclovers boosted the responsiveness of fertilizer programmes by adding considerably to winter feed. It sometimes takes three years for the clovers to build-up, but in all cases topdressing of clovers has proved successful.

9. While 1988 was an excellent season 1987 was quite ordinary. One trial (Binnaway) measured in both years indicated the percentage response to fertilizer was similar in both years.

10. The pasture requirements for sulphur in paddocks with a long history of fertilizer usage (SF45 or single super) is still an area poorly researched. Two trials at Coolah examined this issue, one a black basalt soil (1983 trial) and one a loam soil (1988). Both sites had a long history of topdressing with sulphur fertilizer, but none had been used in the previous four years. The trials recorded 30% and 60% responses to 100 kg/ha SF45. Soil tests indicated high phosphate levels. Tissue testing indicated a level of sulphur below the optimum.

11. In good years such as 1988 fertilizer applied in late March/early April has produced clearly visible responses four weeks later. In drier autumns, such as in 1987, responses were clear by the end of June.

OTHER ASPECTS

Thistles

The Binnaway trial site has a moderate saffron thistle population. In 1988 the spring thistle population in the nil plots was measured at 24 plants/m^2. In the single super plots the population was 1.4 per/m^2. The extra clover competition, for both sunlight and moisture, appeared largely responsible, especially because of the dry hot end to the season. Although fertilized pastures do not always reduce thistle populations, they often significantly do so in dry spring seasons.

Wiregrass

Aristida sp. is common on unfertilized pastures throughout the region and is poorly regarded by landholders. No measurements of wiregrass populations have been made in these trials although it is clear, after only two seasons, that fertilized plots have far fewer wiregrass plants than unfertilized areas.

Economics

It is a common claim that productivity will more than double following a pasture fertilizer programme. Dry matter figures from the Coonabarabran trial programme suggest this is a fair, even conservative, statement. Several farmers in this district, after being involved in fertilizer programmes for between 3 to 7 years, claim a doubling of stocking rate, a greater wool cut, a faster and heavier turn off, less fatalities and improved meat quality. The issue for the future is not whether fertilizer is economical but how often to apply it, at what rate and with what.

FINAL COMMENTS

Pasture country in Coonabarabran and Coolah Shires and almost certainly adjoining areas are, in their natural state, low in sulphur. Many are also low in phosphorus. The fertiliser programmes will result in large increases (often several fold) in autumn-winter-spring feed. In my view, no farmer in this part of the world can afford not to fertilize pastures.

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