OPTIMISING PHOSPHORUS FERTILISER USE ON INTENSIVELY MANAGED PASTURES

Most soils used for agriculture in south-western Australia were acutely phosphorus (P) deficient when first cleared for agriculture. Native vegetation had evolved to cope with the very low P status of the soils but fertiliser P needed to be applied for profitable production of introduced crop and pasture species.

When very deficient, P fertiliser needed to be applied each year, early in the growing season when seedlings were emerging. Any delay in applying this fertiliser greatly reduced crop and pasture yields. Most soils used for agriculture in the region now have sufficient P for crop and pasture production from fertiliser applied over many years. Fertiliser P only needs to be applied when testing indicates that the amount of plant available P in the soil is approaching a predetermined critical level.

An experiment on a dairy farm near Boyanup from 2000 to 2003 showed no response to fertiliser P over the four year life of the trial. This reinforced the recommendation that fertiliser P should only be applied when soil P approached the critical level for that soil.

However, many farmers continue to apply fertiliser P to soils with large soil test P values. This is often seen as insurance against possible reduction in pasture production due to P deficiency.

The aim of the work reported here was to demonstrate the lack of pasture dry matter response to applied fertiliser P on soils with high soil test P values.

WHAT WE DID

Three non-replicated demonstrations were set up in 2005 on three commercial farms in paddocks with high soil P levels that should have been unlikely to respond to freshly-applied fertiliser P. Pastures were the usual mix of Annual and Italian Ryegrass and sub clover. They were all rotationally grazed by milkers and grazing started when ryegrass plants had two to three leaves per tiller. All farmers applied a mixture of urea and ammonium sulphate after each grazing to provide nitrogen (N) and sulphur (S). The N was applied at 1 kg N/ha per day; if it was 30 days after the last grazing, 30 kg N/ha was applied after grazing. The S was applied at 0.36 kg S/ha per day so about 11 kg S/ha was applied if it was 30 days since the last grazing.

The amount of pasture dry matter in each treatment was measured before and after each grazing using a rising plate meter. Subtracting the DM left after grazing from the DM measured before grazing provided an estimate of the DM consumed by the milkers at each grazing and is the DM data shown in the tables.

A major problem with this type of work is that the treatments were not replicated. No statistical analysis could be conducted on the data so we can't be sure that any differences between treatments are 'real'.

Shane Ablett, Cowaramup

Two plots, each 20 m wide and 86 m long, were placed adjacent to one another near the southern end of the selected paddock. No fertiliser P was applied to one plot while 10 kg P/ha, as triple superphosphate, was applied on 18 May to the other. In addition, 50 kg/ha potassium was applied on one quarter of each plot. The four treatments were therefore nil P/nil K, nil P/plus K, plus P/nil K and plus P/plus K. A 'farmer' fertiliser treatment applied to the balance of the paddock was 10 kg/ha phosphorus in May and 50 kg/ha potassium in September.

Shane's results

The paddock soil phosphorus test was 110 mg/kg. This, in conjunction with a paddock PRI of 37, indicated that a response to fertiliser P would be unlikely. The demonstration areas were tested separately and were found to be similar to the rest of the paddock. Pasture and silage production are shown in Table 1.

Table 1: Dry matter produced - Shane Ablett

Fertiliser applied	Grazed pasture t DM/ha	Silage t DM/ha
Nil P/Nil K	1.3	3.7
Nil P/Plus K	2.1	3.8
Plus P/Nil K	2.4	4.0
Plus P/Plus K	2.5	4.3
Farmer treatment	2.2	3.8

The paddock was grazed three times between June and August before being closed up for silage which was harvested in November.

Paul Clarke, Roelands

The selected paddock was cut in half. After each grazing, the whole paddock received 30 kg/ha nitrogen, 7 kg/ha potassium and 6.5 kg/ha sulphur while the Plus-P area received 4 kg/ha phosphorus after the first grazing and 2 kg/ha after grazings 2 to 5. Over the six grazings, a total of 14 kg/ha P was applied to the Plus-P half of the paddock and a total of 180 kg/ha N, 42 kg/ha K and 39 kg/ha S was applied to both halves of the paddock.

Paul's results

The paddock soil test was 112 mg/kg. This, in conjunction with a paddock PRI of 43, indicated that a response to fertiliser P would be unlikely. The two halves of the paddock were tested separately and were found to be similar. Pasture production is shown in Table 2.

Table 2: Dry matter produced - Paul Clarke

Fertiliser treatment	Grazed pasture t DM/ha
Nil P	6.8
Plus P	8.2

The paddock was grazed six times between May and November. There was no apparent difference between treatments for the first three grazings.

Brendan O'Farrell, Albany

Brendan's paddock hadn't received any phosphorus fertiliser for three years when the demonstration started and a soil test in an adjacent paddock was still high enough to suggest that phosphorus fertiliser wasn't required. This was our first mistake – don't pick a demonstration site based on a soil test from the paddock next door.

The second mistake was in assuming that a phosphorus soil test from one laboratory is near enough the same as the test from another lab. Unless they are doing exactly the same analysis, 60 mg/kg reported by one lab may need to be interpreted differently to the same figure reported by a second lab.

The demonstration involved applying 40 kg/ha phosphorus as triple superphosphate on 3 May to a section

of the paddock while the rest of the paddock received no phosphorus fertiliser.

Brendan's results
Pasture DM consumed at each grazing was similar for the Nil P and Plus P treatments for the first three grazings but silage DM was increasingly larger when P was applied. The figures are shown in Table 3.

Table 3: Dry matter produced - Brendan O'Farrell

Fertiliser treatment	Grazed pasture t DM/ha	Silage t DM/ha
Nil P	3.0	3.7
Plus P	3.0	5.2

Sub clover began showing symptoms of phosphorus deficiency at silage time so soil samples were collected and sent for analysis. These tests gave 8 mg/kg P for the Nil-P treatment and 19 mg/kg P for the Plus-P treatment. On this soil, both of these figures indicate that phosphorus fertiliser should have been applied at the break of the season. Test strips of phosphorus were applied to the Nil-P area in early September and an immediate response to the phosphorus was observed.

DISCUSSION

While these results should be viewed with caution due to the lack of replication, they indicate that we may also need to be cautious in assuming that we know all we need to know about the phosphorus requirements of intensively grazed pastures.

The trial at Boyanup showed no reduction in production after four years without phosphorus fertiliser. Some intensively grazed paddocks on Vasse Research Centre have not received phosphorus fertiliser for just about as long and there is no evidence that production is suffering.

The Albany experience also highlights the importance of knowing exactly how your soil test laboratory is analysing your soil samples.

SUBSEQUENT RESEARCH

Because of the limitations exposed in these non-replicated demonstrations and some of the unexpected results, we decided a better approach was to do replicated experiments with four levels of phosphorus applied in three different ways:

1. P applied once only, three weeks after pasture emerged at the start of the growing season (all P applied in autumn, the original recommended procedure)
2. Half the P applied in autumn and half applied in mid-August (more recently adopted by some dairy farmers), and
3. One seventh of the P applied after the first 7 grazings of the growing season (the procedure used by other dairy farmers).

Three of these long-term experiments were started in 2006 on the properties of Peter, Sue and Grant Evans at Jindong, Miles and Dione Mottershead at Witchcliffe and Victor, Denise and Kath Rodwell at Boyanup.

The ten treatments listed in Table 4 are replicated three times. The experiments are located in paddocks that are rotationally grazed to maximise pasture use by starting grazing when ryegrass plants have 2 - 3 leaves per tiller. Similar experiments with K and S were also started in 2006. Table 5 summarises the results from the first year.

Table 4. Treatments used in the long-term P experiment started in 2006

Treatment number	Method of P application	Kg P/ha
1	Nil P	0
2	3 weeks after pasture emergence(autumn)	10
3	3 weeks after pasture emergence(autumn)	20
4	3 weeks after pasture emergence(autumn)	30
5	Half in autumn & half mid-August	2 x 5 = 10
6	Half in autumn & half mid-August	2 x 10 = 20
7	Half in autumn & half mid-August	2 x 15 = 30
8	1/7th after each of the 1st 7 grazings per year	7 x 1.428571 = 10
9	1/7th after each of the 1st 7 grazings per year	7 x 2.857143 = 20
10	1/7th after each of the 1st 7 grazings per year	7 x 4.285714 = 30

Table 5: Total pasture dry matter consumed at all grazings at each site in 2006

P treatment	Total P applied in 2006	DM consumed (t/ha)		
		Mottershead	Evans	Rodwell
No P applied	0	7.0	4.9	7.1
Autumn only	10	6.3	4.7	6.0
Autumn only	20	6.6	5.4	6.1
Autumn only	30	6.5	5.6	5.9
Autumn and spring	10	6.9	4.8	6.4
Autumn and spring	20	6.5	5.1	6.6
Autumn and spring	30	7.0	4.5	6.6
After each grazing	10	6.9	5.5	6.7
After each grazing	20	7.3	5.4	6.3
After each grazing	30	6.5	4.7	6.9
Mean yield		6.8	5.1	6.5

CONCLUSIONS FROM THE REPLICATED EXPERIMENTS

The results show there was no statistically significant response to applied fertiliser P in the experiment at any of the sites in 2006, supporting results from previous research at Boyanup and the recent experience at the Vasse Research Centre of only applying P where the soil test was less than 45 mg/kg. Differences in production between treatments in the unreplicated demonstrations in 2005 were highly likely to be due factors other than phosphorus affecting production in different sections of the paddocks.

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