Proceedings of the New Zealand Grass/and Association 49: 161-165 (1988)

THE CONSEQUENCE OF NOT APPLYING SUPERPHOSPHATE FERTILISER ON TARANAKI DAIRY PASTURE

A. H. C. Roberts and N. A. Thomson
Taranaki Agricultural Research Station, MAFTech, Normanby

Abstract

The effect of withholding superphosphate fertiliser for up to five years on grazed dairy pasture in Taranaki, has been assessed in plot trials. Three sites of different initial soil test phosphate (Olsen P) level were used, viz. 16, 34 and 60.

Seasonal or annual dry matter yields, seasonal distribution of pasture growth, Olsen P, botanical composition and herbage P content were in general, not significantly affected by withholding superphosphate.

A farmlet grazing trial has shown that withholding superphosphate for 18 months did not reduce dairy production in the first season.

Farmers could make large short-term cost savings by withholding superphosphate fertiliser, without affecting dairy production.

Keywords: pasture production, seasonal distribution, botanical composition, dairy production

INTRODUCTION

During the development of dairy systems on the highly phosphate-retentive volcanic soils of Taranaki (PR 85-99%), large inputs of fertiliser have been and continue to be used. Falling product prices and rising input costs necessitate critical evaluation of farm fertiliser policy.

In Taranaki, a survey of commercial dairy farms (Wilson 1984) showed that over the 1979-82 dairy seasons, production averaged 390 kg milkfat (MF)/ha at an average stocking rate of 2.9 cows/ha with an application of 41 kg P/ha. Equivalent figures from the experimental herds at the Taranaki Research Station were 606 kg MF/ha, at 3.6 cows/ha with only 21 kg P/ha applied. While data indicate scope for reduction of phosphate (P) fertiliser applications on well-developed, intensively managed dairy farms in Taranaki, warnings concerning the deleterious effects of reducing or ceasing fertiliser applications on Northland dairy farms have been sounded (Shannon 1986).

This paper describes the effects of withholding superphosphate fertiliser on Taranaki dairy pasture production, soil P status and animal performance.

METHODS

Paddock trials

At the trial sites the local soil type, Egmont brown loam, is classified in the New Zealand system as a yellow-brown loam (Campbell & Wilde 1970); the area is 90 m a.s.l. with a mean annual rainfall of 1244 mm (NZ Meteorological Service 1984). Three paddocks with different initial Olsen P soil test levels (Table 1) were chosen to cover the range from a predicted P responsive site (LP) to a non-responsive site (HP). The LP site was on a commercial farm stocked at 2.9 milking cows/ha and producing 450 kg milkfat/ha, with annual applications of 600 kg/ha 30% potassic superphosphate Fertiliser was last applied at the LP site in the spring before the trial began. The MP and LP sites were on a demonstration farm (adjacent to the LP site) stocked at 4.2 milking cows/ha and producing 604 kg milkfat/ha. Superphosphate was last applied at these sites in 1978.

Each paddock was divided into six 40 x 50 m (approximately 0.2 ha) plots, randomly allocated to two treatments replicated three times, i.e.,

a. Superphosphate plus potassium chloride;

b. No superphosphate plus potassium chloride.

Fertiliser was applied annually in late September; rates of superphosphate (Table 1) at each site were estimated to maintain initial soil P status. Annual applications of 100 kg KCl/ha (Table 1) maintained soil test potassium at 8 or above.

Table 1: Summary of experimental treatments for paddock trials.

Site	Average Initial Olsen P	Treatment	Rate of Superphosphate (kg/ha)	Rate of Potassium Chloride (kg/ha)
LP	16	Superphosphate	250	100
		No Superphosphate	0	100
MP	34	Superphosphate	350	100
		No Superphosphate	0	100
HP	60	Superphosphate	450	100
		No Superphosphate	0	100

The sites were grazed by dairy cows according to commercial practice, and pasture production was assessed after each grazing by mower cuts from duplicate, pre-trimmed exclosure cages on each plot (Lynch 1966).

Pasture samples were collected in October, January, April and July using hand-shears, from each of the 12 exclosure cages at each site, to determine pasture composition and nutrient status. Soil samples (O-75 mm) were taken in triplicate from each plot at the same time, to measure changes in soil P status.

Farmlet trial

The Taranaki Agricultural Research Station, Normanby, at 122 m a.s.l., receives on average 1070 mm rainfall annually and the soil type is Egmont brown loam. Four farmlets at the Station were used for the following treatments:

1. Superphosphate and 3.7 cows/ha
2. No superphosphate and 3.7 cows/ha
3. Superphosphate and 4.3 cows/ha
4. No superphosphate and 4.3 cows/ha

Each farmlet consisted of 10 paddocks with 20-cow herds on total areas of 5.4 ha and 4.6 ha to produce the two different stocking rates. The last previous application of fertiliser on all four farmlets was in September 1985; initial Olsen P levels in July 1986 were 28-30 over all farmlets. The "superphosphate" farmlets received 300 kg/ha 30% potassic superphosphate in September 1986; the "no superphosphate" farmlets received 100 kg KCl/ha only.

Herbage mass was assessed visually in every paddock each week; milk production and composition, cow liveweight and condition were assessed fortnightly. Soil and plant samples were collected from every paddock in October, January, April and July to assess nutrient status.

RESULTS

Paddock Trials

After five years of withholding superphosphate fertiliser, total annual pasture production has not decreased significantly at any site (Table 2), and was typical of yields recorded under mowing in Taranaki (Roberts & Thomson, 1984). Additionally, the HP site has not consistently out-produced the LP site over the five years.

Differences in soil test levels owing to withholding superphosphate were significant in year 4 only ($P<0.01$) at the LP site and years 4 and 5 ($P<0.05$) at the MP site (Table 2). Soil tests at the HP site have not differed.

Over the five years of the trials there has been no consistent change in the seasonal distribution of pasture production at any of the three sites (Table 3).

Table 2: The affect of withholding superphosphate fertiliser on annual pasture production (t DM/ha) and Olsen P soil test for paddock trials.

Site	LP		MP		HP	
	Production	Olsen P	Production	Olsen P	Production	Olsen P
Year 1 No P	11.6	15	11.5	32	13.2	62
P	11.0	16	11.7	36	12.6	57
Year 2 No P	13.0	15	13.6	33	15.2	58
P	12.6	16	14.3	36	14.9	56
Year 3 No P	14.1	15	11.6	36	14.3	59
P	15.1	17	12.0	41	14.5	60
Year 4 No P	11.6	16	12.6	34	12.2	57
P	11.9	18"	13.0	3 9	12.6	63
Year 5 No P	15.1	17	12.9	32	12.2	53
P	15.0	18	13.6	3 9	12.9	57
Average No P	13.2		12.5		13.4	
P	13.2		12.9		13.5	

' p-co.05
" P<0.01
NB: Data analysed within site and year only.

Table 3: The effect of withholding superphosphate fertiliser on seasonal pasture production (t DM/ha) for paddock trials.

Site	LP				MP				HP			
	Su	Au	Wi	Sor	Su	Au	Wi	Spr	Su	Au	Wi	Spr
Year 1 No P	3.3	2.2	1.4	5.1	3.5	1.4	1.5	5.1	3.9	2.3	2.1	4.9
P	2.6	2.0	1.4	5.0	3.2	1.6	1.7	5.0	3.4	2.4	2.0	4.8
Year 2 No P	4.3	2.0	2.2	4.6	3.8	2.9	1.4	5.6	4.4	2.9	2.5	5.4
P	4.5	1.9	2.2	4.2	4.0	3.5"	1.4	5.5	4.3	2.7	2.5	5.4
Year 3 No P	3.6	2.3	1.7	6.3	3.5	1.5	1.9	5.0	3.2	2.7	2.3	5.8
P	3.7	2.4	1.7	7.3"	3.7	1.5	1.9	5.0	3.3	2.7	2.5	5.7
Year 4 No P	3.6	0.9	2.0	5.1	4.8	1.1	1.9	5.0	3.9	1.1	2.0	5.2
P	3.7	0.9	2.2	5.1	4.5	0.9	2.1'	5.5	3.9	1.0	2.1	5.5
Year 5 No P	6.4	3.0	1.4	4.4	5.2	2.4	1.3	4.0	4.5	2.6	1.1	3.9
P	6.3	3.2	1.6	4.0	5.4	2.7	1.6	4.0	4.8	2.9	1.3	3.9

' P-CO.05
" P<0.01
NB: Data analysed within site and year only.

Farmlet Trial

Withholding superphosphate fertiliser since spring 1985 has not affected milkfat production in the first dairying season (Table 4).

The LS groups produced, on average, 60 kg MF/ha more than the HS groups (Table 4), and twice as much herbage was conserved for the LS groups (21 hay bale equivalents cf. 9).

Soil test P decreased to the same extent on all farmlets from July 1986 to July 1987, and was unaffected by treatments (Table 4). In contrast, soil test sulphate was significantly greater (P<0.01) on fertilised farmlets in July 1987 than on non-fertilised farmlets (Table 4).

Table 4: The effect of withholding superphosphate on farmlet milkfat production and soil test.

	3.7 Cows/ha		4.3 Cows/ha	
	Superphosphate	No Superphosphate	Superphosphate	No Superphosphate
Milkfat Production 1986/87 (kg MF/ha)	565	573	506	510
Soil Test P July 1966	30	28	30	28
July 1967	25	23	24	22
Soil Test S July 1966	29	28	28	30
July 1967	30**	24	36"	28

** P<0.01
NB: Statistical analysis applies along rows only

From July 1986 to July 1987 changes in soil test P between farmlets were non-significant, but soil test sulphate had significantly decreased ($P<0.01$) on the non-fertilised farmlets. There were no significant effects of stocking rates.

DISCUSSION

After five years of withholding superphosphate the Olsen soil test P levels for the MP and HP sites have remained well above levels where a response to added P fertiliser would be measureable. Seasonal and annual herbage yield data reflect this, even though at the MP site soil test P has been a significantly ($P<0.05$) lower for the last two years on the areas from which superphosphate has been withheld (Table 2). However, at the LP site, soil tests are in the range where a response to added P fertiliser would be expected, but this has not been reflected in significant differences in either seasonal distribution or annual yields due to withholding superphosphate. Although soil test P in year 4 differed significantly ($P<0.01$) at the LP site (Table 2) seasonal distribution or annual yield did not differ (Tables 2 and 3).

These results can be explained by the chemical and botanical composition of the pasture (Fig. 1). As the pasture chemical analysis for P was within the optimum range of 0.350.40% for pasture growth (Cornforth & Sinclair 1984) at all three sites (Fig. 1), and was not significantly affected by withholding superphosphate, seasonal and annual dry matter production should not decrease. The MP and HP sites were perennial ryegrass and white clover dominant, with some cocksfoot and *Poa* species. The LP site contained less ryegrass and white clover and more Yorkshire fog, cocksfoot, prairie grass, soft brome and *Poa* species, perhaps owing to its lower fertility or less intensive management. Withholding superphosphate for five years has not signifcanlty affected botanical composition at any of the three sites. Therefore, without change in the proportions of grass and legume species or replacement of the dominant grass species with others of different annual growth distribution, alteration of the seasonal distribution of pasture growth through withholding superphosphate would not be expected.

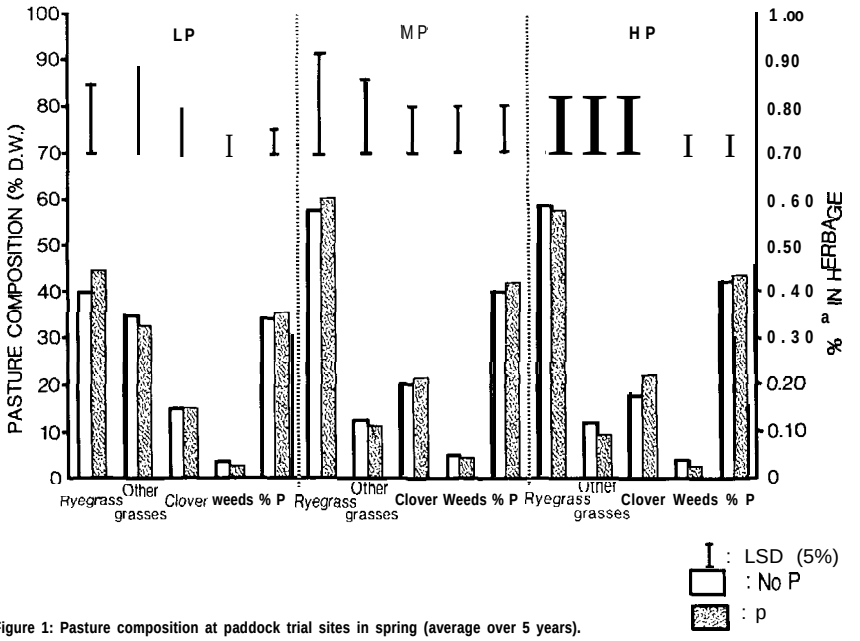

Figure 1: Pasture composition at paddock trial sites in spring (average over 5 years).

In Taranaki, pasture production and soil test P do not decrease rapidly when withholding superphosphate froin grazed pasture for up to 5 years. Evidence from Northland (Shannon 1986) and elsewhere suggests that reducing or ceasing fertiliser for 1 or 2 years will not decrease long-term pasture production, but that to continue longer would affect pasture growth and composition and thus, by implication, decrease animal performance (Feyter & O'Connor 1985; Cornforth & Sinclair 1986; Shannon 1986; Swift 1986).

Although plot trials suggest that withholding superphosphate for 5 years should not affect animal performance, early work in Taranaki (Thomson unpubl.) and more recent work in Northland (Betteridge 1985) has indicated that dietary P levels may limit dairy production over spring and summer. However, at the Waimate West Demonstration Farm, no superphosphate has been applied for the last 8 dairying seasons and average production has been 604 kg MF/ha at 4.2 cows/ha during this time.

In the first dairying season since withholding superphosphate on the farmlets, animal performance has not declined. Soil S levels were significantly lower on the non-fertilised farmlets in July 1987, but not enough to affect pasture and animal production.

The results of the farmlet trial supports the contention that withholding superphosphate for one or two years will have little effect on dairy production (Cornforth & Sinclair 1986; Feyter 1987).

Acknowledgements

J Lagan, S. Fordham and R. Prestidge for technical assistance and the Waimate West Demonstration Farm Committee and the Patterson Estate for trial sites.

References

Betteridge K. 1985. A survey of phosphorus content of pastures and the serum inorganic phosphorus content of dairy cows. *NZ Veterinary Journal 34:* 22-26.

Campbell I.B., Wilde R.H. 1970. Soils. Waimate West County. pp 24-40. *In* Land Inventory Survey, Waimate West County. Department of Lands and Survey, Wellington. 60 p. (Includes N.Z. Soil Bureau Maps 87, 86.)

Cornforth I.S., Sinclair A.G. 1984. *Fertiliser and lime recommendations for pastures and crops in New Zealand.* Second Revised Eidition. Wellington, N.Z. Ministry of Agriculture and Fisheries. 66p.

Cornforth I.S., Sinclair A.G. 1986. Capitalise on accumulated soil fertility. N.Z. *Dairy Exporter 62 (1): 2-3.*

Feyter C. 1987. Effect on dairy production of reduced topdressing. The *New Zealand Farmer, April 9: 50.*

Feyter C., O'Connor M.B. 1985. Fertiliser requirements on high producing dairy farms in the Waikato Annual Report, Agricultural Research Division. N.Z. Ministry of Agriculture and Fisheries.

Lynch P B. 1966. Conduct of field experiments. *NZ Deparment of Agriculture Bulletin 399.*

New Zealand Meteorological Service. 1964. Rainfall observations for 1964. N.Z. *Meteorological* Service *Miscellaneous* Publication *110.*

Roberts A.H.C., Thomson N.A. 1964. Seasonal distribution of pasture producton in New Zealand XVIII. South Taranaki. NZ *Journal of Experimental Agriculture 12: 83-92.*

Shannon P.W. 1986. Sudden slump can follow interval without fertiliser. NZ *Dairy Exporter 61 (12): 39.*

Swift R. 1986. Maintain adequate fertiliser SOS: Save our soils. NZ *Dairy* Exporter 62 *(1):* 3-5.

Wilson R H. 1964. South Taranaki dairy farm survey. N.Z. Farmers Fertiliser Co. Ltd., New Plymouth.