Phosphorus for Dairy Farms

PROJECT MISSION

'Phosphorus for Dairy Farms' is committed to providing practical information based on research for dairy farmers, for the most profitable use of phosphorus fertiliser on farms while continuing to look after the environment.

Victoria
The Place To Be

GippsDairy

Dairy Research and Development Corporation

La Trobe University

PIVOT

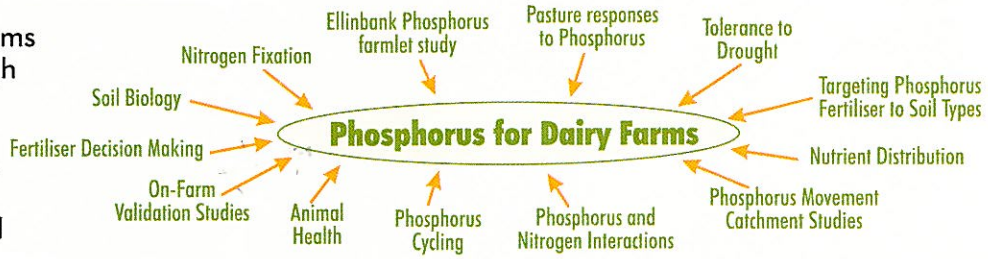
The University of Melbourne

Research information relevant to your dairy farm

BACKGROUND

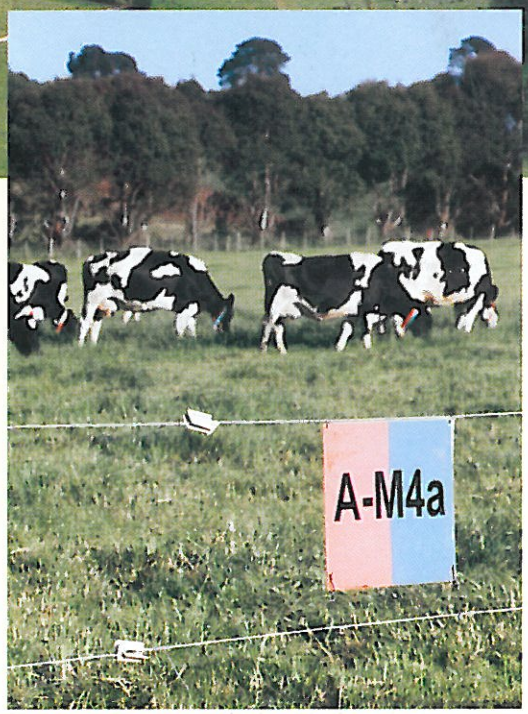
Australian dairy farmers recognise the need for regular fertiliser applications to pastures. These fertiliser decisions equate to about $150 million per year and are clearly important, given the role that nutrients play in maintaining productivity of pastures, and the impact of excess nutrients in the environment.

The Phosphorus for Dairy Farms project was the most thorough and complex research ever undertaken to explore the relationship between phosphorus fertiliser, soils, pastures, milk production and water quality.



Ellinbank Farmlet Study

A detailed farmlet study was undertaken between 1995 and 2001 to define milk production responses from combinations of stocking rates and phosphorus fertiliser rates. The study was based at Agriculture Victoria Ellinbank, West Gippsland, Victoria. Each farmlet comprised of a herd of 15 cows which rotationally grazed 13 paddocks of ryegrass/white clover pasture. Milk production for each herd was measured at every milking for a 290 day lactation period. Herds were also fed hay and grain as required.



Phosphorus kg/ha	Cows/ha			
0	L1	M1		
35	L2	M2a M2b		
70		M3	H3	
140		M4a M4b	H4	

FARMLET DESIGN AND HERD IDENTIFICATION

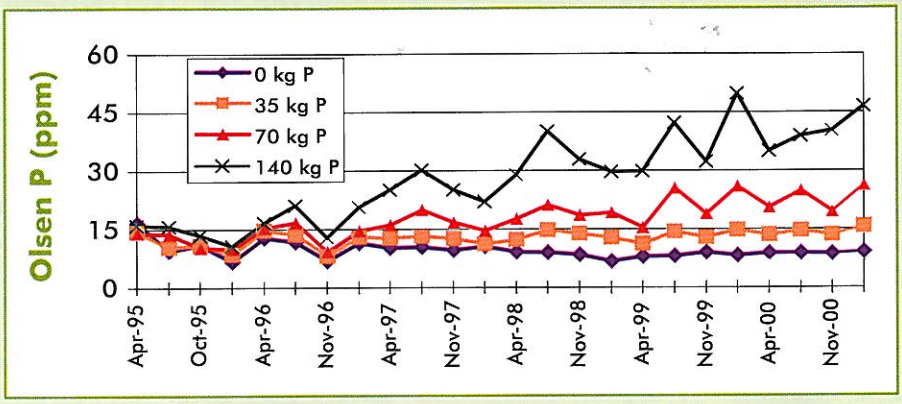
Herds were stocked at 2 (low-L), 3 (medium-M) or 4 (high-H) cows per hectare. Fertiliser rates were applied at 0 (rate 1), 35 (rate 2), 70 (rate 3), and 140 (rate 4) kg of phosphorus (P) per hectare.

There were duplicate herds at 3 cows and 35 kg P/ha (a & b) and also at 3 cows and 140 kg P/ha (a & b).

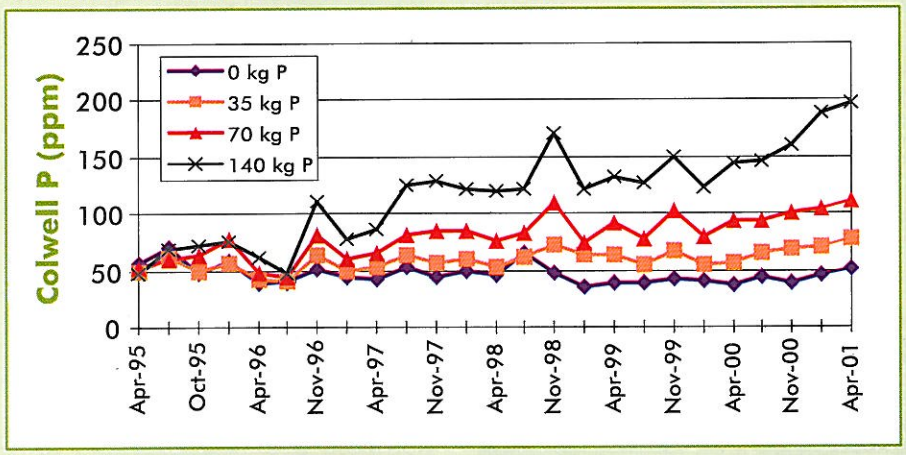
How did soil phosphorus tests change with added fertiliser?

Soil phosphorus (P) levels changed significantly over the six years of the trial due to the different P fertiliser rates. The fluctuations resulted from the twice yearly fertiliser applications and seasonal conditions. Different soil types are likely to result in different phosphorus soil test values.

OLSEN P VALUES FOR
MEDIUM STOCKED FARMLETS OVER 6 YEARS



COLWELL P VALUES FOR
MEDIUM STOCKED FARMLETS OVER 6 YEARS



Did phosphorus fertiliser increase pasture growth rates?

Pasture growth rates increased with increasing phosphorus fertiliser. However, these benefits got smaller as the soil phosphorus levels increased. Due to the high pasture utilisation across all farmlets, there was no effect of stocking rate on pasture growth rates.

AVERAGE SEASONAL PASTURE GROWTH RATES AND OLSEN AND COLWELL P SOIL TEST LEVELS IN THE FINAL YEAR

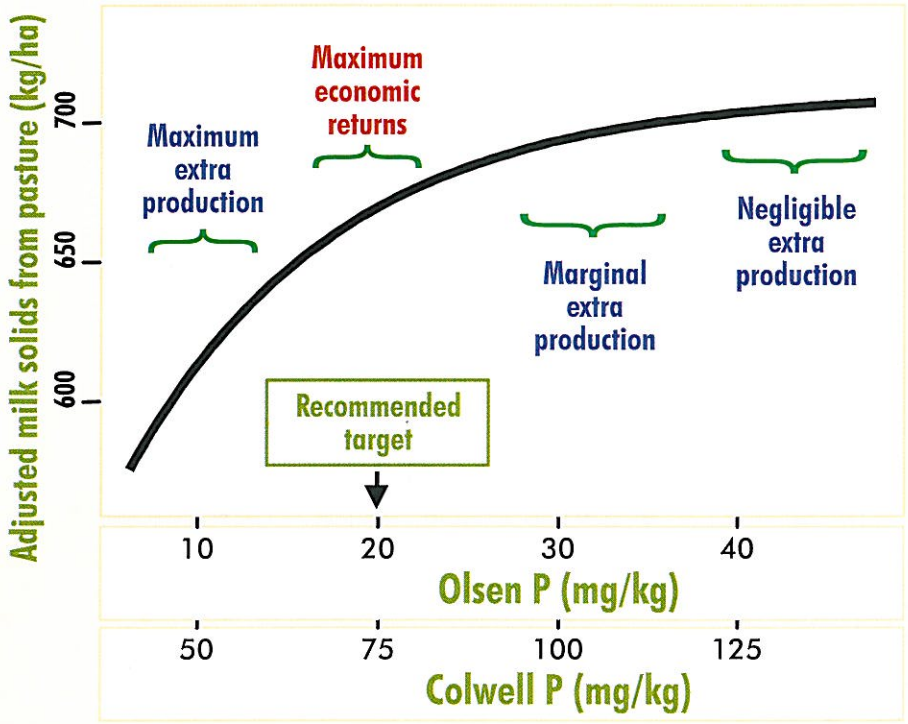
P fertiliser rate (kg/ha/year)	Olsen P in July 2001 (mg/kg)	Colwell P in July 2001 (mg/kg)	Average pasture growth rate (kg DM/ha/day)
0	9	48	20
35	15	79	23
70	27	113	23
140	47	176	24

What were the recommended Olsen P and Colwell P levels?

A greater amount of milk was produced from pasture, with increasing phosphorus fertiliser rate applied. However the benefits decreased as P fertiliser rates and soil P levels increased.

There were only small increases in milk production (<3%) when soil P levels increased from moderate to high levels. The most appropriate Olsen P level was around 18-22 mg/kg, assuming a high pasture utilisation. The most appropriate Colwell P level was around 75-90 mg/kg on this high phosphorus fixing soil.

MILK SOLIDS PRODUCTION FROM PASTURE WITH INCREASING OLSEN AND COLWELL P LEVELS

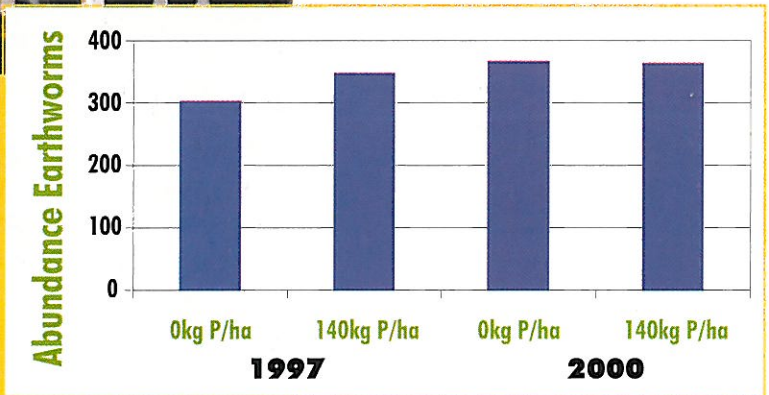


Chasing high soil phosphorus levels is likely to cost more in fertiliser than the returns from additional milk production.

Did fertiliser reduce earthworms and microbes?

Earthworm abundance and species diversity, as well as soil microbe biomass were monitored within the farmlet study. Seasonal conditions resulted in fluctuations in earthworm and soil microbe numbers over the six years of measurement, but there were no detrimental effects of fertiliser use on earthworms and soil micro-organisms.

EARTHWORM ABUNDANCE WITHIN PASTURE SOILS IN SPRING 1997 AND 2000



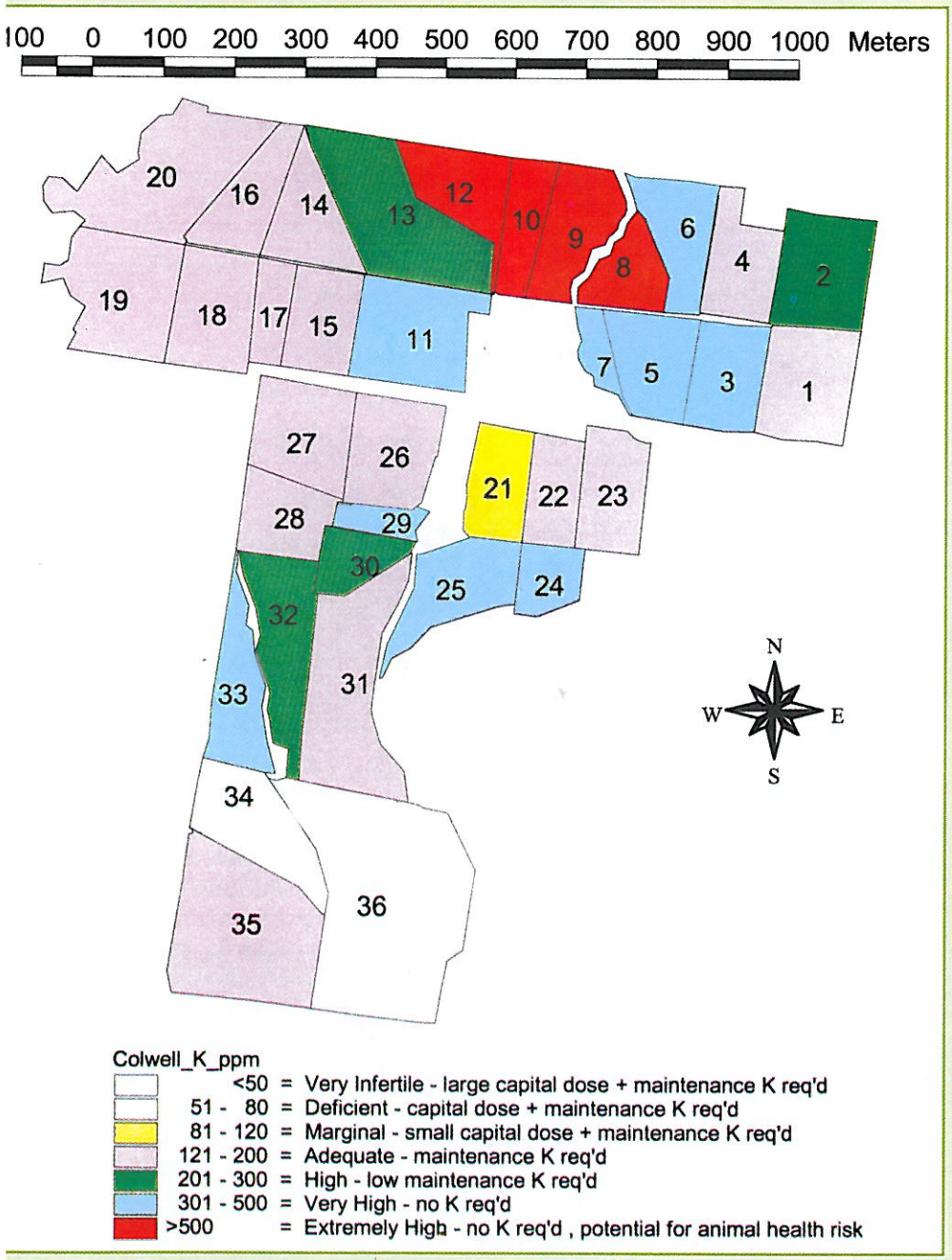
Phosphorus fertiliser even at the highest application rate of 140 kg P/ha each year did not affect microbial biomass carbon or the numbers and species diversity of earthworms.

Is a blanket application of fertiliser good enough for your farm?

The nutrients already present and available within a dairy farm are not evenly distributed. Some areas of the farm will have high or even excessive nutrient levels, while other areas are likely to be deficient. Fertiliser practices that blanket the farm are therefore likely to be over fertilising in some areas and under fertilising in others.

A whole farm nutrient plan involves identifying and soil testing individual paddocks, or even parts of paddocks, on the entire farm. Patterns of low and high fertility can then be identified and blends and rates of fertiliser can be targeted directly to meet the specific needs of each paddock.

One of the best ways to identify the distribution of nutrients within a farm is to draw up a 'whole farm nutrient plan'.



How do I know if applying P fertiliser will make me money?

The results from the Phosphorus for Dairy Farms project have been used to develop a fertiliser estimator that calculates the economic return from fertiliser investment. The estimator is an indicative tool to aid fertiliser decision making.

The whole farm decision estimator is designed to include your farm production and financial details making the estimator unique to your farm. Then you can explore options, ie: 'What is the benefit of raising your Olsen or Colwell P level? What happens if fertiliser, milk, grain and hay prices change?'

The spreadsheet estimator is available from the Phosphorus for Dairy Farms web site, and is also available to consultants and extension staff.

Are different phosphorus fertiliser rates needed for different soil types?

Detailed field studies on 10 different soil types around Victoria has shown that between 5 and 16 kg P/ha is required to raise the soil's Olsen P level by one unit. As the phosphorus buffering capacity of a soil increases, so does the amount of phosphorus fertiliser required to raise the soil test level.

THE AMOUNT OF PHOSPHORUS REQUIRED TO INCREASE THE OLSEN P SOIL FERTILITY LEVEL BY 1 UNIT

	kg Phosphorus/ha/year
Sand	5
Sandy Loam	8
Clay Loam	10
Clay / Red Soil	13
Peats	16

Targeting P fertiliser to soil type will allow farmers to reach target P fertility levels more efficiently and will reduce potential losses of P to the environment.

How do I get the best information from the Phosphorus for Dairy Farms project?

A website for the Phosphorus for Dairy Farms project has recently been developed incorporating research findings, tips and tools, project newsletters, the phosphorus fertiliser estimator and much more.

The website can be found at the following address: **www.nre.vic.gov.au/phosphorusfordairyfarms/**

The project team welcomes any comments or feedback you may have regarding the site and these responses can be posted via the web.

How much nutrient comes in and out the farm gate?

Nutrient auditing can assist in quantifying nutrient requirements at a farm level. Hay and grain brought through the farm gate can contribute a significant amount of nutrients, while product removal in milk and animals is often relatively small.

As stocking rates increase, so does the reliance on supplementary feed. Even without fertiliser many dairy farms will have a net positive balance for potassium, while phosphorus is more likely to be negative or balanced.

ACTUAL POTASSIUM AND PHOSPHORUS IMPORTS AND EXPORTS (KG/HA) FOR 3 DIFFERENT STOCKING RATES IN A GOOD (1998/99) AND A POOR (2000/01) PASTURE YEAR.

Stocking rate/ha		Potassium 98/9	Potassium 0/01	Phosphorus 98/9	Phosphorus 0/01
2 cows	Milk	19	20	10	10
	Feed	28	39	7	9
	Balance*	+9	+19	-3	-1
3 cows	Milk	29	30	15	16
	Feed	52	107	15	22
	Balance	+23	+77	0	+6
4 cows	Milk	36	36	19	21
	Feed	74	184	23	38
	Balance	+38	+148	+4	+17

(* P & K in imported feed – P & K exported in milk)

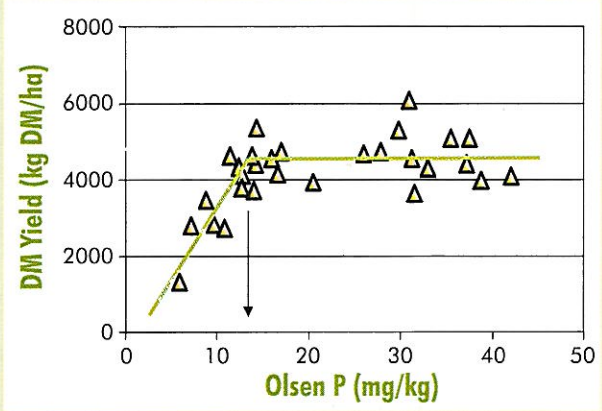
Even simple nutrient budgets can assist in identifying the over or under supply of nutrients at a farm level.

High phosphorus fertility is not required to maximise pasture response to nitrogen.

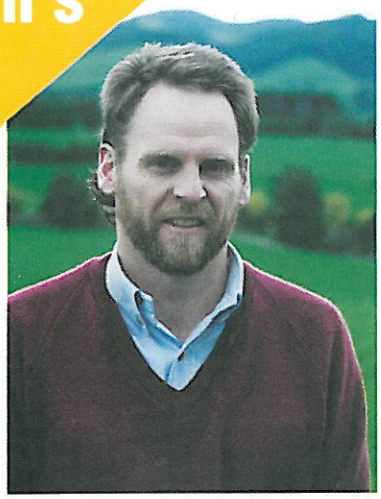
Do I need higher soil phosphorus levels if I use nitrogen?

The pasture growth response to nitrogen fertiliser was measured across paddocks with a broad range of Olsen and Colwell P levels. The additional pasture grown was similar across the differing phosphorus fertilities, except where Olsen P values were <12-14 mg/kg.

EFFECT OF SOIL PHOSPHORUS LEVELS ON PASTURE YIELD RESPONSE TO 80 KG UREA/HA.



Cameron's Corner



The Phosphorus for Dairy Farms project brought together a multi-disciplinary team including dairy farmers, fertiliser advisers, environmental and production scientists, social researchers, economists, and extension specialists, from private, government and educational organisations across Australia. This team has worked within a large research project to define fertiliser requirements and practices, based on dairy cow production, stocking rate and soil characteristics. This research has been unique, as it has included detailed studies of 'whole farm' systems, complemented by experimental work on all major soil types within the dairy regions of Victoria.

The Phosphorus for Dairy Farms project provided valuable new information on many topics related to fertiliser use on dairy farms. This information has been incorporated into tools which mean that phosphorus fertiliser recommendations will be more accurate and relevant across different farms and soil types within Australia. In many cases, this can mean greater milk production on dairy farms, by overcoming current limitations to soil fertility and pasture productivity, worth up to an estimated $16,000 per farm. For many others, a significant reduction in fertiliser use is warranted, with savings of up to 40% of a farmer's fertiliser bill. Moreover, when excess phosphorus fertiliser is not being applied, there is a significant reduction in the potential for phosphorus loss to waterways.

The project has been very well supported by dairy farmers, fertiliser company staff and other industry players. Over 3000 dairy farmers, advisers and service providers have actively sought information from the Phosphorus for Dairy Farms project, by attending seminars, training sessions and discussion groups. More than 2000 people received the quarterly newsletter directly. More than 1000 dairy farmers and advisers attended the Phosphorus for Dairy Farms 'Roadshow' seminars across Australia. The major fertiliser and soil testing companies have incorporated the project outcomes into the services they offer dairy farmers. In addition, information from the project is channelled through a broad range of other private, government and educational organisations, and is currently reaching a large proportion of dairy farmers across Australia.

The Phosphorus for Dairy Farms project team are proud of the contribution they have made to better nutrient management on dairy farms and sincerely thank the Australian dairy industry for their support over the last seven years.

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