FACTSHEET

# Hill Country Futures: Phosphorus requirements

*April 2022*

Phosphorus (P) is an essential plant nutrient for pasture growth. Clovers are less competitive than grasses for P, so fertiliser inputs are required to assist the legume on nearly all New Zealand hill country farms. This is because all New Zealand soils are low in plant-available P.

The biggest annual transfer of P from the grazed pasture is from animals grazing low slope areas and depositing P in dung in areas where they camp, rest and ruminate. This transfer reduces the amount of P available to plants.

Given P is important for legumes, expensive to apply and can have a detrimental impact on waterways, it makes sense to apply the required amounts precisely and strategically.

## Key messages

- Across the farm, soil P should be monitored regularly to inform fertiliser applications.
- Unless P fertiliser is applied to maintain P losses, pasture production and profitability will decline.
- The test of soil P is known as the Olsen P test. At low soil Olsen P levels (i.e. <10-12), apply above maintenance rates of P to increase soil P and pasture production to Olsen P of 15+ (depending on soil type).
- In lower annual rainfall hill areas (i.e. less than 800 mm), there are significant economic benefits from applying higher rates of P on easier slopes and shady aspects, where there is generally more legume present.
- Significant increases in profitability can result from adopting variable P application technologies to apply the right amount of fertiliser to each land unit.

## Trends in soil Olsen P

P fertiliser is usually the single biggest expenditure item in the farm budget. Therefore, it is critical that the farm has accurate soil test and livestock production records.

If possible, establish annual trends in soil Olsen P levels to determine the required rate of P for your farm. You can get a clear picture of trends by carrying out an annual soil test across at least five paddocks for at least five years. You should test the same area in the same five paddocks every year. Samples should represent the different land units on your farm. These may include flat versus hill areas and north versus south facing slopes.

If the trend over time is reasonably constant and within the optimal range, the rate of P applied is maintaining the soil P status and the existing production system.

If the soil P levels are declining, it may explain declining pasture production levels.

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## Value proposition

There is a strong correlation between:

a. P fertiliser use and profitability in hill country, and
b. Soil P status and pasture recovery following a drought.

Unless P fertiliser is applied to balance annual P losses, pasture production will decline.

## Capital vs maintenance P

**Capital P:** P fertiliser inputs above maintenance to increase soil Olsen P levels.

**Maintenance P:** Annual rates required to maintain pasture production by replacing P removed in meat and wool production, held in soil or transferred in dung to low slope and stock camps.

## When to use capital P

1. To increase Olsen P from <10, up to the optimal economic range (15+ depending on soil type).
   → Apply 45-70 kg P/ha (i.e. 500-750 kg superphosphate/ha).
2. If drilling a pasture and P is needed;
   → Apply as one dressing around the same time as sowing the pasture, so full allocation of P is available to help with early growth.
   → Use a soluble P fertiliser (e.g. superphosphate or di-ammonium phosphate (DAP)) so it is immediately available. If using superphosphate, that will also provide sulphur (S).

## When to use maintenance P

General guidelines:

- At stocking rates of 6-12 SU/ha, annual maintenance rates will range from 10-20 kg P/ha/yr (i.e. 100-250 kg superphosphate/ha/yr).
- These rates will replace P losses and so maintain soil Olsen P values at current levels.
- Reactive phosphate rock (RPR) is an option as a maintenance P fertiliser where annual rainfall is greater than 800 mm. The choice to use an RPR should include a consideration of the cost per kg of P compared with other P sources like superphosphate.

## Environmental considerations

Phosphorus in soil is tightly bound to soil so management strategies that reduce soil erosion also minimise P losses and reduce negative impacts on stream health. Excess inorganic P in waterways encourages undesirable weed and algal growth.

P concentrations in the soil and pastures are elevated in the weeks/months after application of a water-soluble P fertiliser (i.e. superphosphate). This increases the risk of P losses in soil run-off.

P fertilisers with a high critic soluble P, but low water soluble P, like lime revert superphosphate, Dicalcic phosphate, Serpentine super, and to a lesser degree RPP, reduce the risk of P losses in run-off.

## Time of application

P can be applied any time of the year. However, be aware of rainfall and therefore the risk of soil erosion.

P is mainly retained in the soil, so the time of application is not as critical as nutrients that can be leached, such as nitrogen (N) and S.

If soil Olsen P levels are <10, apply P in early spring so the pasture, and importantly the legume, can take maximum advantage of the application.

## Slopes and legume content

Pasture on easy slopes is more responsive to P than on steeper slopes. This is because easier slopes grow more legume, which in turn boosts N in the soil and increases total pasture growth.

Traditionally, P fertiliser has been spread aerially over hill country farms at a uniform rate, despite some areas having a higher legume content (i.e. flat and easy slopes). These higher legume content areas:

a. Require more P than steeper hill country, and
b. Grow significantly more dry matter per kg of P applied.

This table shows how much more pasture is grown on flat and easy slopes, compared with steep slopes, on a per kg P applied basis.

| | Slope class (pasture growth – kg DM/kg of P applied) | | |
|---|---|---|---|
| Research trial site | Flat | Easy | Steep |
| Waipawa | | 128 | 66 |
| Ballantrae | 408 | 296 | 217 |
| Whatawhata | | 595 | 337 |

## Applying P fertiliser at variable rates

The technology for topdressing planes to variably apply P accurately across different slopes, aspects and areas is now available.

Trials and whole farm modelling show significant increases in profitability (10-30%) from variable application, compared with uniform aerial spreading.

Precision application can also reduce the risk of direct application of P to water bodies.

## Conclusion

Establishing annual trends in soil Olsen P is the optimal starting point. You are then able to determine if you need capital or maintenance P, and if it is an economic objective that fits into your farm system. From there, you can tailor a P fertiliser programme to suit your property. Today, fertiliser programmes include the option of using P fertiliser with different amounts of water soluble P and variable application technology to maximise your investment and help protect waterways.

## Further reading

This factsheet is part of the Hill Country Futures soil and fertiliser series. The full series can be found at www.hillcountryfutures.co.nz/resources/soil-and-fertiliser-series

"Fertiliser use on New Zealand sheep and beef farms" booklet, produced the Fertiliser Association of New Zealand booklet. Download at: www.fertiliser.org.nz/Site/resources/booklets.aspx

"Minimising phosphorus losses from agricultural systems when using phosphorus fertilisers" guidance note, produced by the Fertiliser Association of New Zealand booklet. Download at: www.fertiliser.org.nz/Site/resources/fact-sheets.aspx

"Winter fertiliser P application" advisory, produced by the Fertiliser Association of New Zealand booklet. Download at: www.fertiliser.org.nz/Site/resources/fact-sheets.aspx


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