# PROFITABLE LIMING STRATEGIES FOR PASTURE RENOVATION

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There is substantial evidence that a large proportion of Australian soils which receive annual average rainfall in excess of 500 mm are acidifying. Increasing soil acidity is as much a threat to sustainable production as the more visible forms of land degradation. The solution to soil acidification will, sooner or later, include the need to use lime.

Strategies for profitability in any endeavour must be to minimise costs and to maximise benefits. In this paper we attempt to set out guidelines on how this can be achieved with liming for pasture renovation.

**To minimise cost of lime**

Lime is a high cost input in an extensive agricultural production system. It is important to get value for money when buying lime. Liming materials vary in price but cost must be calculated in terms of effective neutralising value of the material spread of the paddock.

Fine particles will react in the soil quicker than coarse particles. Particles larger than 0.7 mm are not effective but will cost you in transport and spreading (the Fertilizers Act requires lime to contain not more than 20% of this coarse material). A cheaper price should also apply to products in which less than 90% pass through a 0.25 mm screen (check your label). An efficiency rating developed by Ohio State University is given below:

**Table 1 Efficiency of lime in relation to particle size.**

| Particle Size | % Efficiency |
|---|---|
| less than 0.25 mm | 100 |
| 0.25 mm to 0.70 mm | 60 |
| o.70 mm to 2.4 mm | 20 |

The other important information on lime bags is neutralising value (NV). The higher the NV the greater the ability of the product to raise soil pH. The Fertilizer Act requires lime to have a NV of at least 70.

To compare the real cost of alternative products calculate for each:

1. % Efficiency (from Table 1)
2. % Effectiveness (PE)
   $PE = Efficiency \times NV$
3. Ex works cost per effective tonne (EWC)
   $EWC = \$/tonne \times \frac{100}{PE}$
4. Transport cost per effective tonne (TCE)
   $TCE = \$/km/tonne \times distance \times \frac{100}{PE}$
5. On farm cost per effective tonne (OFCE)
   $OFCE = TCE + EWC$

**Cost of spreading lime**

An even spread is desirable to ensure that the correct rate of lime is obtained. Current spreading costs vary from $10 to $15/tonne. Direct drop machines are best and may be worth paying a little extra for.

**Incorporate lime if possible**

Lime is almost insoluble! Surface applied lime will move down the soil profile slowly taking several years before the full benefit of lime is achieved. The bank however will demand immediate repayment of interest and capital!

Effective incorporation of lime requires two passes with a tined implement. In a pasture-crop rotation apply lime before sowing the first crop of the rotation. In pasture paddocks consider a limited cropping programme. The cultivation associated with cropping will ensure effective lime incorporation before pasture establishment.

Where erosion is likely and full cultivation is not desirable you may consider:

(a) Strip cropping, where cultivated and uncultivated strips alternate across the slope. In one year the cultivated strip can be ploughed and limed while the other strip can be treated the following year. The uncultivated strips are more efficient if they are allowed to accumulate a heavy body of feed which protects against erosion.

(b) Topdress, using a very fine grade of lime, but be prepared to wait longer for results.

**Timing of lime application**

Early application allows much of the reaction of lime with the soil to take place before sowing. At least six to eight weeks before sowing should be allowed. An additional advantage is that some companies offer a discount on early orders.

**<u>To maximise benefits of lime:</u>**

1. <u>Apply lime where you are most likely to get significant production responses</u>. To achieve this:

(a) check for the following symptoms,
- poor patches in pastures
- poor nodulation in legumes
- yellow patches in crops
- acid tolerant species perform better than sensitive ones.

(b) Take soil samples,
- 20 to 40 cores per paddock, to cultivation depth
- Some samples should be taken from the subsoil This is important in choosing appropriate species for renovation
- Samples should be taken at random or using a grid pattern over a representative area.

(c) Soil analysis should include pH and exchangeable calcium, magnesium, potassium, sodium and aluminium .

(d) Consult a professional.

2. <u>Consider other factors:</u>

When liming it is doubly important to get everything else right. Use the available technology to ensure a successful establishment. Remember that lime does not replace fertilisers. In some soils liming may reduce the availability of s

Use table 2 as a guide.

Table 2 Sub. clover varietal tolerance to root rot (*Phytophthora clandestina*)

| | |
|---|---|
| Larisa | Highly resistant |
| Trikkala | |
| Karridale | |
| Dalkeith | Very tolerant |
| Esperance | |
| Daliak | Tolerant |
| Junee | |
| Clare | |
| Mount Barker | Susceptible |
| Seaton Park | |
| Green Range | |
| Enfield | |
| Woogenellup | Very susceptible |
| Nungarin | |
| Northam | Extremely susceptible |

(Source: Dr. Peter Taylor IRI Tatura)

3. Use the optimal lime rate:

Based on overseas experience, several approaches to lime rate recommendations have been adopted:
- Regional recommendation (ie. "X" t/ha on soil type "Y" in region "Z").
- Target soil pH (ie. all soils to be limed to pH "X").
- Target exchangeable aluminium (ie. add lime to get exchange able aluminium level down to "X" % of exchangeable cations).
- Variable target pH or exchangeable aluminium levels depending on species and their tolerance of acidity and aluminium toxicity.

These methods may be adequate in the regions for which they were developed, where in general the cost of liming at 2.5 t/ha is less than 10% of the value of the crop produced. In southern NSW however, where lime costs are high and income per hectare relatively low, 2.5 t/ha typically costs between 50% and 100% of the annual product value. In view of the critical need to make the best possible use of such a high cost input, we must address the following questions:

(i) Assuming that we have correctly identified a lime responsive paddock, can we predict the extent of crop, pasture and animal production increase to various amounts of lime applied?
(ii) What is the long term residual value of lime?
(iii) Will the farmer make a profit?
(iv) What will happen if he does not use lime?
(v) How does the investment compare with alternatives on or

off the farm?
(vi)What is the payback period on a loan required to finance liming costs?

In order to address these questions, initially for long term sub clover based pastures, we developed a computer model called "Lime-It". It is designed to be used by advisory professionals (eg district agronomists) sitting down with a farmer (or a small group of farmers) at a micro-computer. The model provides technical and financial information based on farm specific information. The farmer is free to "try out" several options before deciding on the answer which best suits his management goals.

More specifically "Lime-It" is made up of four submodels:

**The soil submodel** - using NSW Department of Agriculture soil test results for any paddock, this submodel calculates how well buffered a soil is with regard to pH changes. This information is then used to predict the effect of any rate of lime on soil pH and exchangeable aluminium. Re-acidification after liming is calculated over a ten year period. Longer term predictions can be obtained by multiple runs, using previous output and nil lime as inputs.

**The pasture submodel** - Two "typical" lime response curves, which were derived from on-farm experiments, are used to generate examples of "more" and "less" responsive sub. clover based pastures. The response to lime is re-calculated annually to account for re-acidification as predicted by the soil submodel. We stress at this stage, that diagnosis of the likelihood of a lime response on a particular soil depends on more information than is used in "Lime-It". This is one reason why "Lime-It" must be used in conjunction with an advisory officer.

**The livestock submodel** - The model calls for information on current stocking rate. We then assume that all additional pasture production can be utilised if the stocking rate is increased in proportion to the increased feed available. The amount of additional stock required and the associated costs are calculated.

**The economic submodel** - Given reduced marginal returns and limited finance, the economic optimum is unlikely to be at the same input level as the biological maximum. In "Lime-It", three economic criteria are used to assist managers in selecting a lime rate: marginal analysis, internal rate of return and cash flow analysis.

The model is not infallible but we believe it reflects the best available information and enables users to apply that information to specific paddocks.

With new research findings on soil acidity and lime use, we will update the model to ensure that it continues to reflect the "state of the art".