TO LIME OR NOT: A GUIDE TO OPTIMISING INPUTS AND PROFITS

WHY LIME SOILS?

This is a three-part article which will address the fundamentals of liming in agriculture. Key questions to be addressed include:

- why liming is important
- which liming agents to use
- how to apply liming agents.

A. WHY is liming is important and why should a farmer consider the extra cost which comes with liming? Nutrition management is one of the key pillars in making or breaking a cropping venture. Fertilizer use efficiency (what we put in vs what is taken up by crops) will largely determine the profitability of farming, all things being equal.

At this point one may ask "Is there is ever a scenario where applied fertilizers are not taken up by crops?" The answer is an emphatic **YES**!

The soil has to be in good condition for it receive nutrients supplied as fertilizers and hold them in a usable state by plants. One critical measure of soil condition is its level of acidity or alkalinity, which is termed the pH. It is expressed on a scale of 1 (acid) to 14 (alkaline) where 7 is the neutral point or the pH of pure water. Soil pH influences crop growth in two ways. Its direct negative effect on the physical condition of the plant and secondly it has an effect on nutrients in the soil. Most crops perform best if soil pH is within the range 6 to 7.5. It is also within this range that most plant nutrients in the soil become readily available for uptake by plants. Anything below or above this range constitutes a hostile growing environment and extra resources have to be deployed to achieve the same yields as when using lime - balanced soils. The following table gives a guide on how much of the 3 macronutrients Nitrogen, Phosphorus and Potassium (NPK) is taken up at a given soil pH.

Nutrient uptake efficiency with pH

	pH 4.5	pH 5.0	pH 5.5	pH 6.0	pH 6.5
N	**30%**	**43%**	**77%**	**89%**	**100%**
P	**23%**	**31%**	**48%**	**52%**	**100%**
K	**33%**	**52%**	**77%**	**100%**	**100%**

Taking phosphorus (P) as a reference nutrient, if farmer **X** with soil at pH 6.5 (100% efficiency) uses 10 bags of fertilizer, another farmer **Y** with soil at pH 5.5 (48% efficiency) would have to apply 20 bags of fertilizer to get the same response. Farmer **Y** is clearly getting huge losses. Fortunately for farmer **Y** there is a cheaper way in which he can match his colleague **X.** An application of **LIME** guided by the starting pH and the soil type will recondition his soil to improve fertilizer uptake efficiency and provide an ideal growing environment for his crops. It should be noted that we cannot avoid acid accumulation in the soil, as it is induced by ammonium fertilizers, acidic parent material and leaching of alkaline compounds from the soil., Farmer **Y** must not rest on his laurels however, as with time, he will end up in the same situation as **X** if he does not practice **maintenance liming** for each season fertilizer is used.

B. WHICH LIMING AGENT TO USE

Once it has been established that soil is too acidic, the next question is

“Which liming agent should I use and at what rate?

There are at least 4 liming agents that can be used, though 2 of these are the most commonly used for reasons we will see.

1) **Dolomitic Lime**
    a. composed of **calcium carbonate** and **magnesium carbonate**.
    b. It is a source of both calcium and magnesium for the soil.
    c. The product is in its natural chemical form since it is simply mined and crushed without further processing.
    d. Dolomitic lime is particularly useful when one seeks to raise soil pH in a magnesium - deficient soil.
    e. It also has the highest neutralizing value of all unprocessed liming agents.

2) **Calcitic Lime**.
    a. It is mostly composed of **calcium carbonate** though it may carry trace magnesium carbonate.
    b. It is also chemically unprocessed and is mostly used when one wants to limit magnesium in their soil.
    c. It is believed that a soil with too much magnesium is not friable (difficult to achieve fine tilth). As a general rule, when soil magnesium is 75ppm and above, then calcitic lime is recommended.
    d. Recent research has shown that calcium to magnesium ratios in soils do not necessarily influence uptake of these ions therefore these cannot be accurately used as a basis for selecting between calcitic and dolomitic lime.

These two agents are very popular with farmers because of their relatively lower cost and non-caustic nature. They are however less soluble hence require more time and proper soil incorporation to be effective.

3) **Burned Lime** or **Quicklime**.
    a. This is made by heating limestone or dolomite in a kiln to drive off the carbon dioxide to form calcium oxide (or calcium and magnesium oxide).
    b. It is very caustic but has the highest neutralizing value, also more rapid-acting than crushed limestone.

4) **Slaked Lime** (calcium hydroxide).
    a. This is made by burning limestone or dolomite in the presence of steam.
    b. It is also rapid-acting like burnt lime.

Hydrated and Burnt Lime are not popular with farmers due to their higher cost and caustic nature which presents handling problems.

C. HOW MUCH LIME TO USE

The amount of lime needed to raise soil pH by one unit varies greatly from soil to soil. In fact, one soil may require double or three times as much lime as another to achieve the same rise in pH, even though both have the same initial pH.

a) This is mainly governed by the amount of negative charge present in the soil.
b) The more these charges are available, the more lime needed to achieve same result and vice versa.
c) Heavy clay soils carry a lot more negative charge compared to lighter soils hence they require more lime per unit area. However they maintain pH for longer meaning liming requirement is less frequent (every 3 to 4 years).
d) Lighter soils on the other hand need less lime to achieve pH change due to carrying less negative charges.
e) Lighter soils however leach much faster hence liming needs to be frequently done (every 1 to 2 years).
f) Key considerations when choosing a liming agent are neutralizing value, purity and of course the cost.

General lime requirement by soil type:

	pH 4.5 to pH 5.5	**pH 5.5 to pH 6.5**
Sand / loamy sand	600 kg / ha	900 kg / ha
Sandy loam	1,100 kg / ha	1,550 kg / ha
Loam	1,700 kg / ha	2,200 kg / ha
Silt loam	2,700 kg / ha	3,100 kg / ha
Clay loam	3,350 kg / ha	4,200 kg / ha

Lime Application:

a) Care must be taken to NEVER OVERLIME.
b) It is generally advisable to raise pH by a maximum of 1 full unit per season
c) As an example, let's say a farmer has a sandy loam soil at pH 4.5 and intends to raise the pH to 6.5. Instead of applying 2,650kg/ha (1,100 kg + 1,550 kg in table above), he is better off splitting the applications between two cropping cycles.
d) If done wrongly, **over-liming** will result, which can be worse than not liming at all.
e) Required lime quantity should be spread evenly and then incorporated into the soil to the root zone level.
f) Proper incorporation is necessary since calcitic and dolomitic lime have low solubility in water, therefore they will not move significantly from the point of application. They have to be placed at the site of action which is the root zone.

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