**MURRAY DAIRY - AUTUMN START-UP WORKSHOPS.**

**Technical Note: ACIDIC TOPSOILS & SOIL HORIZONS.**

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**Description of the issue and importance:** Acid topsoils are common throughout northern Victoria where annual rainfall exceeds 450mm/year, or where soils are permeable and leaching has occurred from rainfall or irrigation. Soil acidity within loam, sandy clay-loam and clay-loam textured topsoils is common caused by:

- Leaching of rainfall or irrigation water
- Application and leaching of nitrogen from nitrogenous based fertilizers, such as Urea, MAP or DAP.
- Application and leaching of sulphur from sulphur based fertilizers, such as Sulphate of Ammonia or Gypsum.

As soil acidity increases, several processes occur:

- Essential macro-nutrients and trace elements have reduced availability for pastures or crops. Over-application of nutrients typically counterbalances poor availability.
- The availability of exchangeable aluminium increases, which can prune or limit pasture or crop root development. A restricted root system then limits the AWC and level of available nutrient.
- The environment for plant growth is less favourable under an acidic condition.
- The environment for soil biological functioning is less favourable and mineralisation of organic matter may decline as soil pH becomes more acid.

**Problem Identification:** Indicators to determine the presence and extent of acid soils include:

1. Soil test results showing soil pH (water) levels of <6.5 or pH ($CaCl_2$) of <5.5.
2. Soils that show strong responses to lime application.
3. Poor pasture or crop performance, particularly in the early stages of development.
4. Poor plant root growth, particularly in the A horizons or the most acidic zone.
5. Pastures or crops that show strong responses to base fertilisers.
6. Limited biological activity.
7. Duplex soil conditions where the A horizons are light textured. Textures include sandy loams, light sandy clay loams and sandy clay loams.

It is important that the depth of the acidic layer is revealed by testing soil pH down the profile. The depth of each layer should be confirmed and boundary between acidic and non-acidic horizons defined. A hand soil pH test kits can be used to determine the approximate soil pH (water) level. Figure 1 is a photograph of samples from the Shepparton region tested with a hand test kit.

**Figure 1. Photograph showing samples from various soil horizons tested for soil pH (water) using the hand test kit. Samples on the left are $A_1$ and $B_1$ horizon samples showing acidic soil pH levels.**

**Management options:** Most growers and agronomists are familiar with the presence of acid soils and the best approaches for management. Liming is accepted industry practice for adjustment of acid soils. Agricultural lime is ground and screened calcium carbonate. When applied, soil in contact with lime which is acidic dissolves the surface of lime particles, then hydrogen in the soil exchanges for calcium on clay exchange sites. The carbonate fraction converts to CO2 (carbon dioxide) a greenhouse gas up taken by plants. Free hydrogen and oxygen join and form water. This process in an acidic soil yields an increase in soil pH, increased nutrient availability and improved conditions for plant growth and biological activity.

Lime rates for soil amelioration should be based on a volume of lime required to neutralise soil by a set rate. Traditional lime volumes are applied using a rule of thumb formula:

1.0 t/acre or 2.5 t/ha is required to raise soil pH by 1.0 unit per 100mm of soil.

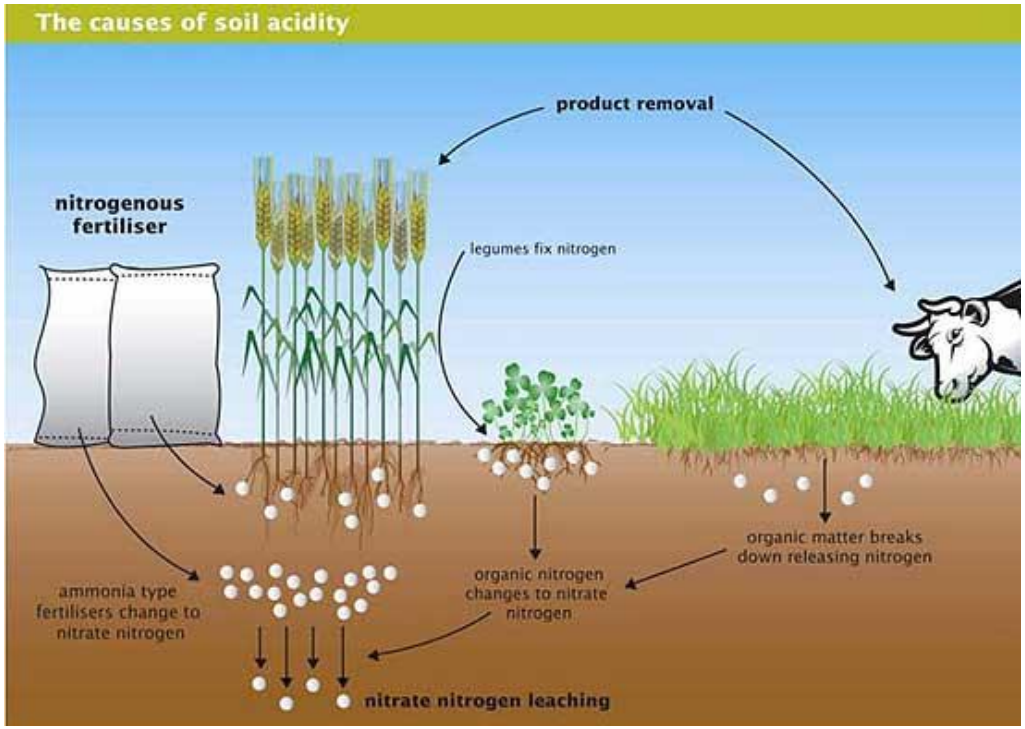
This formula is a guide only and varies depending on the starting soil pH level. Using this guide, the total volume of lime required to raise soil pH by 1.0 unit for 150mm of topsoil is approximately 3.75 t/ha. This approach may not prove cost effective for many businesses and a lower rate approach applied on a more frequent basis may yield a more effective outcome.

Lime particle size should also be considered in the process of selection. In general, the finer the lime, the more effective it is at neutralising soil pH. Effective Neutralising Values (ENV's) of 90% or greater should be preferred.

In all cases where soils require amelioration, an evaluation of the cost-effectiveness of liming for adjustment of pH should be evaluated. In some soils, other chemical or physical parameters require amelioration ahead of liming. These may include treatment of dispersive or sodic soil.

Crops and pastures can be selected to better handle acidic soil pH levels. Some of these varieties include phalaris, cocksfoot, oats or triticale.

**SOIL ACIDITY PROCESS & LIME-SOIL REACTION.**




http://agriculture.vic.gov.au/agriculture/farm-management/soil-and-water/soils/acid-soils

LIMING REACTION

$$\begin{matrix} H \\ H \end{matrix}\boxed{\text{Clay}} + CaCO_3 \rightarrow Ca\boxed{\text{Clay}} + H_2CO_3 \rightarrow H_2O + CO_2$$

Eliminates $H^+$ as water

http://www.spectrumanalytic.com