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NRM Plan

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Managing Soil Acidity

Sustainable Agriculture in the Northern and Yorke NRM Region

The Northern and Yorke Natural Resources Management region has a range of naturally acid soils and these soils are prone to further acidification under certain agricultural management practices.

The area of agricultural land in the region with acid soils is approximately 270,000 ha or 13% of the region. The area affected by acidity is increasing under agriculture. Acid soils are found in the higher rainfall districts which have higher leaching of nutrients in the soil, on lighter textured soils which have little clay or organic matter to buffer the acidifying effects and in areas which have a history of high production, legume growth and / or nitrogen fertiliser use.

Soil acidity is a condition of soil where there is an excess of hydrogen ions present and is measured by pH. Soils can vary in pH down the soil profile. Acidic soils are usually more acid near the surface and less acidic, or even alkaline, at depth where higher quantities of clay can buffer the acidification, or where there may be calcium carbonate present which neutralises the acid.

Acid soils occur from the lucerne flats of Marrabel, through the intensive cropping and grazing areas near Clare, Farrell Flat, Spalding to Jamestown and the Southern Flinders Ranges from Beetaloo to Wilmington. Some small areas of acid soils exist on Yorke Peninsula.

Preventing soil acidification

As soils acidify plant growth and yields decline, soil health declines, microbial activity declines and nutrient imbalances become evident. It is much more efficient and effective to treat soils for acidity before these problems occur.

See Figure 1: Prevention is the best strategy

Reduced soil fertility

- **Poor plant growth and reduced productivity** – plants which are sensitive to acidity will decline in growth and productivity allowing weeds to increase or reduce soil cover which can lead to soil erosion. Plants sensitive to acidity include canola, lucerne, barley, beans, peas, medics and wheat. Yields have been reduced by >30% on soils with a pH (CaCl2) 4.5-5.0 in the region. Tolerant plants to acidity include lupins, some wheats, triticale, oats and sub clovers.

Figure 1:
Prevention is the best strategy

Start Liming when below Target Soil pH level	Target pH $CaCl_2$	Target pH Water
Extensive grazing*	5.0 – 5.5	5.8 – 6.3
Intensive grazing / Cropping*	5.5	6.3
Vines / Olives	5.5 – 6.5	6.0 – 7.0

*Target can vary with treatment of surface soil acidity or subsurface acidity

- **Nutrient loss** – in strongly acid soils, potassium, calcium and magnesium can be depleted by leaching or removed in products such as hay and grain. A lack of calcium can also contribute to soil structural problems.
- **Nutrient tie-up** – nutrients such as phosphorus and manganese can become unavailable as soil acidity increases (Figure2).
- **Phosphorus inefficiency** – phosphorus combines with free aluminium and iron released in acid soils and becomes less available to plants. Molybdenum is also less available.
- **Reduced microbial activity** – microbes which fix nitrogen or decompose organic matter are less active in moderately and strongly acidic soils.
- **Declining land values** – loss of productive capacity due to acidity can reduce land values.

Increased soil toxicity

Toxic levels of aluminium and manganese – are released into soil solution as pH (CaCl2) drops below 5.0. Aluminium (Al) toxicity is a problem when soil extractable Al levels are >2mg/kg or exchangeable Al is >5%. Toxic levels affect root growth and the soil biota.

Soil structure/clay degradation – strongly acidifying conditions breaks down the clay minerals releasing aluminium and iron and damages the soil structure. Damage to the clay components of the soil is irreversible.

Stock health – acid soils with low levels of calcium and magnesium can contribute to the risk of grass tetany in grazing livestock

Off-site effects

- Increased risk of soil erosion through the reduced amount of soil cover and increased runoff with subsequent water pollution and deposition in streams.
- Increased dryland salinity through decreased plant water use, increased recharge and subsequent watertable rise in the catchment.
- Increased pollution of groundwater and surface water due to leaching of nitrate, other nutrients and heavy metals from the soil profile.

Management of acid soils

Liming

Lime (calcium carbonate) and other liming materials reduce acidity by neutralising the acid reaction in the soil. The finer liming material with a higher purity and higher neutralising value (NV) preferably >80% provides a quicker response.
Gypsum does not neutralise acidity.

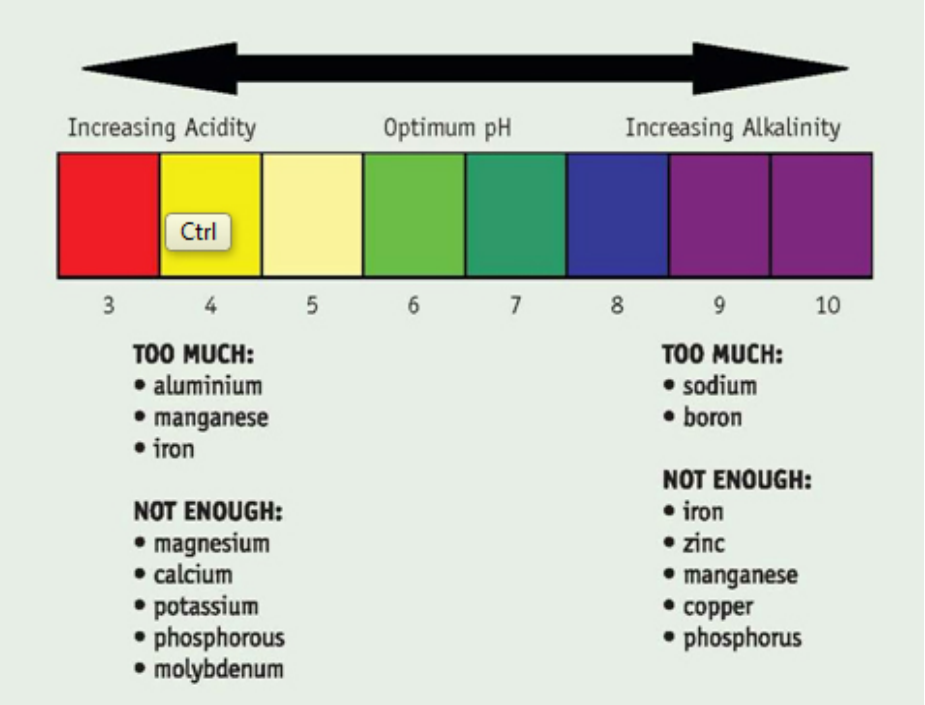
Prevention is the best strategy

Apply lime before productivity is lost so apply when the soil drops below the target pH. Monitor soil pH every 5 to 10 years to determine the timing of the next lime application. Acidification can occur down the soil profile. Check the sub surface layers (10-20cm) if the surface soil (0-10cm) pH is low.

Factors affecting Liming

- **Soil texture** – sandy soils require less lime than clays to change soil pH. Because of their higher buffering capacity clays take longer to acidify but need more lime to change the pH

Figure 2: Soil pH and nutrient availability



- **Rate of lime applied** – in the region rates vary from 1.0 to 3.0 tonnes per hectare depending on the soil pH and soil texture. Higher rates can reduce frequency of applications. Even spreading is essential. Caution: High lime application rates can induce manganese deficiency especially on sandy soils
- **Desired pH range** – the lower the soil pH, the more lime is needed to recover ideal levels. In soils where the sub-surface layer (10-20cm) pH is low the surface pH may need to be maintained at a higher level through liming to enable movement of lime into the sub-surface layer.

Other practices to reduce the rate of soil acidification:

- **Rates of N fertilisation** – high rates of ammonium fertilisers accelerate acidity. For example the use of equivalent amounts of urea in place of sulphate of ammonia or MAP will slow pH change. Match fertilizer use to expected production so that nitrate is used by plants and not leached from the soil.
- **High percentage of leguminous crops and pastures** – grow crops or pastures with high nitrogen requirements to utilise nitrogen produced by legume crops and pastures.
- **Rate of product removal** – hay cuts and intensive cropping systems with high productivity remove more alkalinity in grain and hay so the rate of acidification is higher in these paddocks. Monitor the soil pH of these paddocks more frequently. Grazing remove less alkalinity in meat, milk and wool.
- **Claying sands** – certain clays applied to acidic sands to improve water infiltration and soil nutrient capacity can provide a liming effect.
- **Fertigation practice** – vine growers and other irrigators applying nitrogen fertilisers and surface water through driplines and sprinklers need to monitor pH and acidification rate within the wetted zone. Liming the wetted zone or using calcium nitrate as the nitrogen source are the best options if the area is acidified.

Further information

Help and Assistance

NRM Authorised Officers
Riverton – 8847 2544
Kadina – 8821 1555
Orroroo – 8658 1086

Figure 3: Spreading lime in the region