GOVERNMENT OF WESTERN AUSTRALIA

Department of **Agriculture and Food**
Department of **Regional Development and Lands**

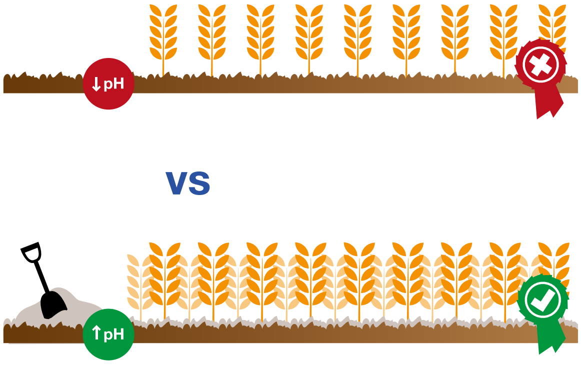
ROYALTIES FOR REGIONS

Carbon Farming in WA

Fact sheet No. 15

PRACTICE: **Soil amelioration through the application of lime**

Description of practice



Soil acidity management and liming are key issues to get right in regard to soil quality improvement for agriculture in Western Australia. Sustainable management of soil, in particular carbon, is essential for the viability of the industry. Increasing the carbon retained in soil (also known as sequestration) improves soil quality and can also help to reduce atmospheric carbon dioxide. The extent to which increased production will contribute to increased sequestration will depend on the capacity of the soil to protect a greater amount of organic matter than is already present in the soil (Murphy et al. 2012). Findings by Murphy et al. address 'actual' versus 'attainable' carbon storage in sandplain soils in Western Australia. Achieving the attainable carbon storage requires maximum plant growth and maximum returns (plant residues and manures) in any farming system. Therefore, to increase carbon storage in soil, it is important that management practices remove any constraints to plant growth, where it is cost effective to do so.

Acid soils cause significant losses in production, restricting crop and pasture choice. Soil with an acidity constraint will impact on the levels of biomass able to be grown given the available water. In the wheatbelt of Western Australia, acid soils restrict the access of roots to subsurface moisture and nutrients later in the season (due to aluminium toxicity at low pH). About 80 per cent of topsoil (0–10 cm) samples collected from the wheatbelt since 2006/07 have a pH ($CaCl_2$) below the recommended target of 5.5 and 50 per cent of the samples collected from the subsoil (10–20 and 20–30 cm layers) have a pH below the recommended target of pH ($CaCl_2$) 4.8. Applications of agricultural lime may correct soil acidity.

Outline of procedure

Western Australian land managers use four main techniques to manage soil acidity:

- application of liming material
- use of acid tolerant plants

The Department of Agriculture and Food is the lead agency and is working with the Department of Regional Development and Lands to deliver this Royalties for Regions funded project.

For more information please refer to agric.wa.gov.au

More Information

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- use of management practices that reduce the rate of acidification to a minimum
- application of other types of neutralising agents.

The Department of Agriculture and Food, Western Australia (DAFWA) supports the use of lime as the primary ameliorant for soil acidity. Lime has an important role in improving and maintaining soil condition and 'good' soil pH.

Lime used in the south-west of the state is mostly limestone (naturally occurring crushed or sieved limestone), while lime-sand is mostly used in the Midlands, Central and Upper Great Southern regions. Both forms are used in the Lower Great Southern. About 10 per cent of the total lime used in Western Australia is in the form of dolomite (crushed or sieved deposits of calcium and magnesium carbonate), which is mainly used in the Lower and Upper Great Southern regions. Burnt lime, a by-product of the cement industry, supplies 5–10 per cent of lime used in the state. Agriculture in Western Australia is well serviced by lime suppliers, although the quality of lime varies markedly around the state and cost does not always reflect quality as measured by neutralising value and fineness. Neutralising value and particle size distribution (fineness) are significant factors of lime quality that govern the amount and rate of pH change in the soil over the short term (six months to a few years). Nonetheless, applying agricultural lime is the most economical way of ameliorating low soil pH in cropping areas in Western Australia (Gazey 2011).

There are numerous publications and websites addressing lime and liming procedure (see key reference list).

Work done to date

DAFWA has coordinated a long-term soil acidity management trial in the Kellerberrin area. From this trial, which is examining soil pH trend over time, soil samples have been tested for nutrients and soil organic carbon (SOC). Even though the trial sites with lime addition have long been producing extra yield and biomass, the level of SOC remains unchanged. The assumption for this result, while speculative, is that the more suitable pH plots turned over biomass faster through increased microbial action and the attainable limit on the sandy soil had been reached. On the soils with a higher clay content, where the attainable carbon limit has not been reached (for whatever reason, including acidity), the assumption is that creating more biomass would add to the actual SOC and approach the attainable SOC content. Essentially, the trial demonstrates no increase in soil organic carbon over the long term.

Current level of adoption

Lime is underused in Western Australian agriculture. Lime use is currently around 1 million tonnes per annum (*State of Environment* report 2011), with the estimated volume of lime required about 2.5 million tonnes per year for each of the next 10 years to achieve soil pH targets. This infers that the current adoption of liming practice to achieve the required soil pH target is around 40 per cent.
It is believed that the practice of liming for the benefit of increasing SOC is not likely to become an eligible activity under the Emissions Refuction Fund (ERF) because it is common practice to mitigate soil acidity. Investigations by Murphy and Barton (University of Western Australia) and Sanderman (2012) have also demonstrated issues associated with leakage, that is, that carbon dioxide is released from the soil when lime is applied. Considerable effort has been undertaken to assess the supply and quality of agricultural lime resources in Western

Australia. DAFWA initiated and continues to work with the Western Australian Lime Industry Association (known as Lime WA Inc.) on pit locations and independent audits of lime quality at association member pits (Gazey 2009, 2011). There is strong engagement with grower groups and other regional environmental or natural resource management organisations, extending and promoting the benefits of agricultural liming for improved soil quality. Through a previous campaign known as Time to Lime (and a more recent campaign, Time to Re-Lime), adoption by the agricultural community of the practice of (and understanding of the need for) liming has steadily improved.

Industry activity

Liming has been widely accepted as the soil ameliorant for correcting low pH in acid soils. While it does improve crop and pasture production on poor performing, low pH soils, liming is not a practice currently implemented for the 'sole purpose' of actively increasing the level of soil organic carbon.

There is limited research directly investigating the practice of liming for the impact or benefit on SOC. However, from many liming and soil acidity management trials conducted across Western Australia in the past, reinterpretation of the data (where SOC has also been measured) may provide useful supporting information. Murphy and Barton are currently involved in trials investigating nitrous oxide emissions and lime application, as well as whether soil amelioration through liming will either deplete SOC content or improve the soil's capacity to build SOC through increased biomass production.

Carbon benefits

Currently none.

Co-benefits

- Ameliorating acid soils with lime is addressing the loss and cost of production to growers from soil acidity (estimated at between $400 million and $500 million per year).

Opportunities

- The area of land available for the practice of liming to improve soil condition, soil pH and agricultural production is about 80 per cent of the Western Australian wheatbelt. The gains in regard to improving SOC stocks are unknown because the gap between actual and attainable carbon is highly variable and site specific.
- There is greater recognition of soil acidity as a widespread constraint by growers and agronomy consultants, and grower uptake of applying lime for initial soil amelioration, together with applied maintenance rates, is increasing.
- Commercial potential: improved soil quality increases soil organic content. Increasing SOC is considered a benefit regardless of whether sequestered carbon is traded.

Risks

- Liming for the benefit of carbon stocks runs the risk of distracting from the key message of ameliorating soils for soil acidity and reducing loss of production potential from poor performing low pH soils.
- A better understanding of the attainable limits and ability to maintain the increase in SOC is required.
- Permanence – maintaining it for 100 years
- Proving additionality: prove that it is not common practice
- Leakage – carbonate limes dissolve and release bicarbonate ($2HCO_3$), which evolves into CO_2 and water (H_2O).
- Uncertainty of voluntary market price for SOC

Case studies

- Kellerberrin lime trial (DAFWA): data and results suggest there is no difference in SOC increases with the addition of differing volumes of lime (Gazey, personal communication).
- Liebe grower group: a long-term soil biology trial (UWA, DAFWA and the Grower Group Alliance), which was initiated in 2003, demonstrates five ongoing stubble management regimes with a number of associated soil condition measures, including actual soil carbon values (carbon stock), soil biology and soil pH. Results are available by contacting the Liebe grower group.
- The Soil Carbon Research Program (Soil Carbon WA project): this program involves 1000 soil sites across seven different sampling areas in the south-west of Western Australia. Paddock history has been collected for every site (up to 10

years) and comprehensive soil analysis data also has been collected. The results may show better correlation for soil pH and SOC storage.

Key contacts – Western Australia

- Chris Gazey (DAFWA)
- Dr Fran Hoyle (DAFWA)
- Dr Dan Murphy (UWA)
- Louise Barton (UWA) is investigating liming and SOC, and CO_2 gas release
- Grower Group Alliance, specific groups, including the Liebe grower group
- DAFWA, including Jeremy Lemon, David Hall and Doug Abrecht
- Western Australian No-Till Farmers Association
- Private agronomy consultants
- Lime WA Inc.

Key references

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