Managing subsoil acidity

No.1, September 2016

Innovative approaches to managing subsoil acidity in the southern grain region (GRDC: DAN00206)

Project overview

Welcome to the first issue of 'Managing subsoil acidity'. In this issue we provide an overview of this major GRDC funded project that commenced in 2015. This issue also highlights the framework and key features of the experimental design for the long-term field experiment near Cootamundra.

Project background

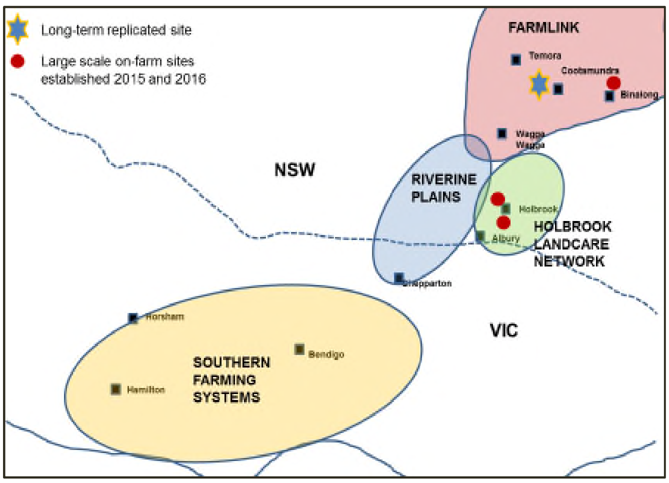
Subsoil acidity is a major constraint to crop productivity in the high rainfall zone (500–800 mm) of south-eastern Australia. The surface application of lime is commonly used to combat topsoil acidity. However, lime moves very slowly down the soil profile so subsoil acidity will only be ameliorated after years of surface application. In addition, at the current commercial rates of about 2.5 t/ha, most of the added alkalinity is consumed in the topsoil and has limited effect on neutralizing subsoil acidity or counteracting subsoil acidification.

Project aim

This project will investigate innovative technology to deliver novel soil amendments, such as calcium nitrate and magnesium silicate, lucerne pellets as well as lime directly into the subsoil (10-30 cm) to ameliorate acidity.

Target region

The project covers major high rainfall cropping areas from southern NSW to south-west Victoria.



Experimentation

A long-term field experiment was established in 2016 at Dirnaseer, west of Cootamundra, NSW, to monitor long-term soil chemical, physical and biological processes.

A range of laboratory soil incubation studies and glasshouse experiments will be conducted under controlled environments to compare effects of various combinations of soil amendments on soil amelioration processes. These will inform the most efficient soil amendments, optimum rates and best placements in the soil profile.

A series of large scale field experiments will also be conducted on farmers' paddocks to demonstrate the benefits of the most effective soil amendments and innovative technologies across different soil and climate conditions in NSW and Victoria.

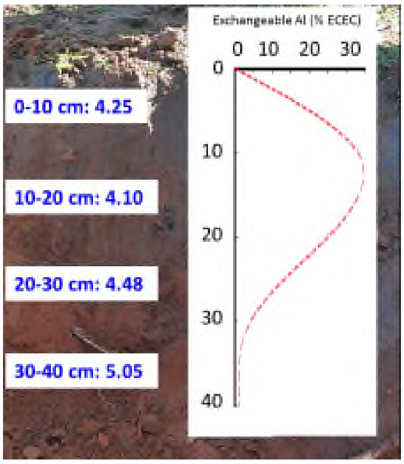


Figure 1 Typical soil profile at Holbrook, NSW (Sodosol) with low pH and high exchangeable Al to a depth of 30 cm.

Project partners and contacts

Organisation	Key contact	Telephone
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Framework of long-term field experiment

'Ferndale', Dirnaseer, West of Cootamundra, NSW

Objectives

- To manage subsoil acidity through innovative amelioration methods that will increase productivity, profitability and sustainability.
- To study soil processes and measure the long-term changes in soil chemical, physical and biological properties.

Treatments and design

- Four crops in sequence
- Six soil amendments
  - o Control, no amendment
  - o Surface liming, target pH 5.5 at 0-10 cm
  - o Deep ripping only (30 cm depth)
  - o Deep ripping + lime, target pH 5.0 at 0-30 cm
  - o Deep ripping + lucerne pellets (15 t/ha)
  - o Deep ripping + lime + lucerne pellets
- Three replicates in a split-plot design

Table 1 Crop rotation cycle and phases

		Phase 1	Phase 2	Phase 3	Phase 4
Year 1	2016	**W1**	C2	B3	F4
Year 2	2017	C2	B3	F4	**W1**
Year 3	2018	B3	F4	**W1**	C2
Year 4	2019	F4	**W1**	C2	B3
Year 5	2020	**W1**	C2	B3	F4
Year 6	2021	C2	B3	F4	**W1**
Year 7	2022	B3	F4	**W1**	C2
Year 8	2023	F4	**W1**	C2	B3
Year 9	2024	W1	C2	B3	F4
Year 10	2025	C2	B3	F4	**W1**
Year 11	2026	B3	F4	**W1**	C2
Year 12	2027	F4	**W1**	C2	B3
Year 13	2028	**W1**	C2	B3	F4
Year 14	2029	C2	B3	F4	**W1**
Year 15	2030	B3	F4	**W1**	C2
Year 16	2031	F4	**W1**	C2	B3

Crop code: W1, crop at phase 1 as wheat; C2, crop at phase 2 as canola; B3, crop at phase 3 as barley; F4, crop at phase 4 as faba bean for early sowing, or field pea for late sowing.

Key features

- **Phased design**. There are 4 crops in the rotation, arranged in a fully phased design. Each crop will appear once in any given year *a*) to assess responses of different crops to different soil amendments; *b*) to compare treatment effect, taking account of seasonal variation.
- **Crop rotation cycle**. One crop rotation cycle will take four years to complete with the crop sequence as wheat-canola-barley-grain legume.
- **Soil amendment cycle**. Soil amendments will be applied every 8 years in years 1 and 9, pending availability of funding.
- **Soil samples**. All soil samples will be archived for long-term storage.
- **Data management**. All data will be uploaded into the Katmandoo database.

Measurements

- **Soil chemical properties**
  - o Deep soil coring at 10 cm intervals to 40 cm and 20 cm intervals from 40 to 100 cm
  - o Shallow soil coring at 10 cm intervals to 40 cm
  - o pH in $CaCl_2$; exchangeable Al, Ca, Mg, Mn, K and Na
  - o Soil total C and N, organic C (Heanes)
  - o Colwell P
- **Soil physical properties**
  - o Particle size distribution
  - o Soil aggregation stability
  - o Penetrometer measurement
- **Soil biological properties**
  - o Soil microbial diversity
  - o Earthworm population and biomass
- **Soil moisture and root depths**
  - o Neutron moisture meter measurements
  - o Rooting depth and root density
- **Agronomy measurements**
  - o Establishment count
  - o Tiller count
  - o Anthesis DM
  - o Harvest DM
  - o Grain yield and quality

Project partners: NSW Government Department of Primary Industries, La Trobe University, Charles Sturt University, Graham Centre, CSIRO, FarmLink, Holbrook Landcare Network, Riverine Plains, SFS

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