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FarmLink Research Report 2016

Innovative Approaches to Managing Subsoil Acidity in the Southern Grain Region

GRDC Project code – DAN00206

Project Partners

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NSW Government Department of Primary Industries

Holbrook Landcare Network

Charles Sturt University

CSIRO

RiverinePlains

La Trobe University

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Funding Partners

GRDC Grains Research & Development Corporation

Trial Site Location

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Introduction

The project targets the high rainfall zone (500-800mm) South-Eastern region of Australia where subsoil acidity (10-30cm) is a major constraint to crop productivity. Surface liming is a common practice used to tackle topsoil (0-10cm) acidity. However, lime moves very slowly down through the soil profile so the subsoil acidity won't be ameliorated until years after the surface application. There is also the problem of most of the added alkalinity being consumed in the topsoil prior to reaching the subsoil to neutralize the acidity.

The objective of this project is to increase awareness of subsoil acidity and to demonstrate the effectiveness of innovative technology to ameliorate and/or prevent subsoil acidity on a farm scale. FarmLink has been tasked with investigating more aggressive ways of alleviating subsoil acidity under field conditions and delivering key messages to growers, agronomists and consultants to facilitate the adoption of these new innovative subsoil acidity management techniques.

Objectives

FarmLink's role is to establish two paddock scale replicated experiments to –

- Increase awareness of subsoil acidity
- Demonstrate effectiveness of innovative technology to ameliorate and/or prevent subsoil acidity on a farm scale

Method

The first of the large-scale on-farm experimental sites was established in February 2016 at Binalong NSW, in the east of the FarmLink region. The site was located in the high rainfall zone (HRZ), with an average annual rainfall of 647mm. The paddock had a high acidity and high exchangeable aluminium, fitting the trial site selection criteria perfectly.

Characteristics	Target Site	Actual Site
0-10cm: pHCa (CaCl2)	pHCa (CaCl2) 4.0-4.5. If limed, preferring <5.0	pHCa (CaCl2) 5.75
10-20cm: pHCa (CaCl2)	pHCa (CaCl2) < 4.3, exchangeable Al% >20%	pHCa (CaCl2) 4.24, 18.83%
20-30cm: pHCa (CaCl2)	pHCa (CaCl2) pHCa < 4.6, exchangeable Al% >10	pHCa (CaCl2) 4.26, 13.29%
Annual Rainfall	>500mm	647mm
Rotation	Cropped for 3 consecutive years	Canola, TBA, TBA

Table 1. Target trial site characteristics vs actual.

	Treatments	Description
1	Surface liming	The site received 3.5t/ha of lime in 2015. The pH at 0-10cm was 5.75 in 2016 as shown in table 3. Therefore, no additional lime was added.
2	Deep ripping only	Ripping occurred at a depth of 30cm and at width 50 cm between ripping lines. Once again, the surface was not limed due to liming in 2015.
3	Deep ripping + lime	For this treatment, 2.6 t/ha of lime was placed at 10-30cm to target the subsoil acidity.
4	Deep ripping + organic amendment	As above with organic amendment, lucerne pellets at 15t/ha.

Table 2. treatments and descriptions for 2016 Binalong site

The trial included four treatments, replicated three times. The four treatments were surface liming, deep ripping, deep ripping with lime and deep ripping with an organic amendment. Lucerne pellets were selected as the organic amendment. See Table 2 for a more detailed description of the treatments.

The treatments were implemented using a duel depth delivery (3-D) ripping machine designed and fabricated by NSW Department of Primary Industries. The 3-D ripping machine allows lime and other organic amendments to be accurately placed at two depths from 10 – 30cm. Using his own equipment, the grower planted 970CL grazing canola at 3kg/ha on 300mm spacings at a 45° angle to the deep ripping lines (Figure 1 right). This was to ensure uniform performance of crop to the treatments. Ideally, the crop should be sown each side of the ripping line using a seeder with 250mm row spacing to maximise treatment effect (Figure 1 left). However, the farmer's equipment was set to 300mm spacings so the alternate plan was implemented.

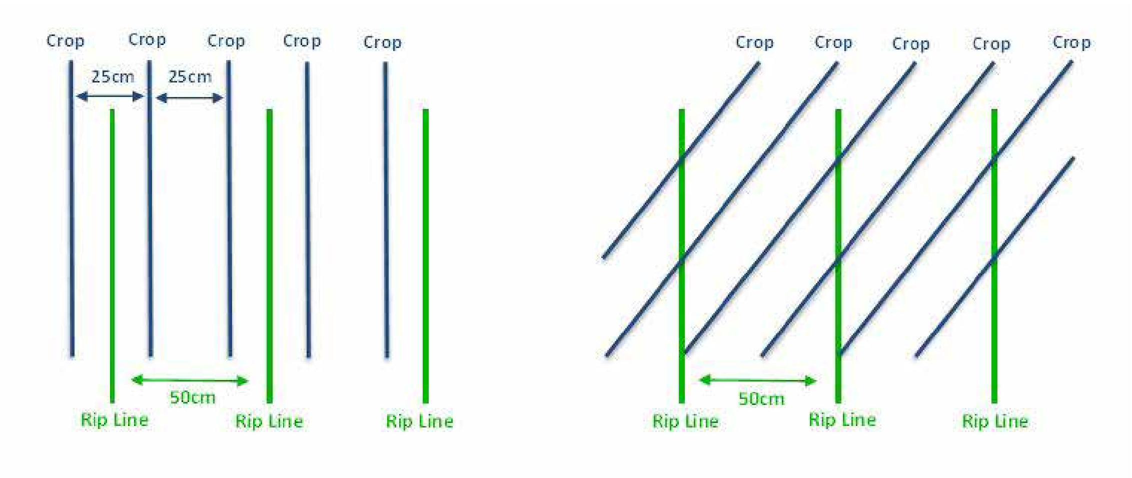

Figure 1. Initial crop sowing plan (left) vs new plan (right)

Following crop emergence and throughout the season data collected included - emergence counts, anthesis and harvest dry matter cuts, header yield data, grain quality testing and initial and final soil sampling. Another farm scale site will be set up in February 2017. The site will have the same selection criteria, treatments and assessments.

NB: these parameters will be assessed at this site for the next two years.

Results 2016

Initial soil samples were taken prior to the treatments being implemented (Table 2). At the end of the experiment, in the third year, final soil samples will be taken to compare the pH and exchangeable aluminium percent at depths from 0-100cm. Results from initial soil samples showed that the exchangeable aluminium and acidity spikes greatly in the 10-30cm profile and begins to increase downwards from 30cm.

During emergence, it appeared that the surface liming treatment had the highest emergence count of 32.6 plants/m2, while the deep organic amendment treatment had the lowest with an emergence count of 18.5 plants/m2. This equates to a difference of 14 plants/m2.

The harvest dry matter cuts follow a different trend when compared to the emergence counts. The deep organic amendment treatment had the highest dry matter cut weight just prior to windrowing, with a weight of 22.9 t/ha. The surface liming treatment had the lowest dry matter weight of 17.6 t/ha, even though it had the highest emergence counts. That's a dry matter weight difference of 5.3 t/ha between the surface liming and deep organic amendment treatment.

	0-10cm	10-20cm	20-30cm	30-40cm	40-60cm	60-80cm	80-100cm
pH (CaCl2)	5.75	4.24	4.26	5.02	5.74	5.96	5.97
Exchangeable Aluminium %	0.70	18.83	13.29	0.94	0.27	0.19	0.20

Table 3. pH (CaCl2) and exchangeable aluminium percentage from the initial soil samples

Treatment	Emergence Counts (Plants/m2)	Harvest DM Cuts (t/ha)	Quad Harvest Yield (t/ha)
Surface Liming	32.6	17.6	3.6
Deep Ripping	21.5	18.4	4.0
Deep Liming	24.4	21.3	4.7
Deep Organic Amendment	18.5	22.9	4.7

Table 4. treatment averages of assessments taken throughout the year

The deep liming and deep organic amendment treatments had the highest quad cut harvest yield, with both treatments bringing in 4.66 t/ha. The surface liming treatment had the lowest yield. There was a 1.1 t/ha difference between the highest and lowest yield.

Discussion

During emergence, surface liming had a substantially higher emergence rate when compared to the other treatments. This may be the result of the canola seed not having a good seed-to-soil contact in the other treatments. It is likely that air pockets were formed when the deep ripper loosened the soil, causing the small canola seed to be unable to absorb enough moisture at germination. Canola should be placed into a seedbed that is firm, level and moist (GRDC, 2009). The GRDC canola best practice management guide states that sowing into loose or 'fluffy' soil should be avoided (GRDC, 2009). Observations during emergence found that although the surface liming treatments had high plant populations, the plants seemed to be less mature.

This immaturity followed through to anthesis where it was observed that the surface limed treatments continued with the high plant density, but had thin stems, while the other treatments, although plant density was lower, seemed to have thicker stems. Where plant populations are low, plants compensate by producing extra branches (GRDC, 2009). The ability for the canola to compensate for poor emergence was so good that the deep ripped plots had a higher dry matter weight just prior to windrowing. Other variables may have contributed to the differences in weight between the three deep ripped treatments, such as the lime or lucerne pellets distributed at depth. The plots with the lucerne pellets at depth were slightly taller than the other treatments, which may be due to the breakdown of the lucerne pellets into plant available nutrients.

The quadrant cut yields were measured by cutting three one metre square quadrants out of each strip; threshing and calculating an average yield for each treatment. Hand harvest yield follows the same trend as the harvest dry matter cuts, surface liming had the lowest yield and lucerne pellets having one of the highest. However, lime at depth also had the highest yield results, even though the dry matter cuts were lower, meaning that the harvest index (yield/dry matter=HI) for this treatment is higher.

This trial is a large-scale experiment, the data collected provides an indication of treatment effects and demonstrates benefits and pitfalls of adopting these subsoil acidity management methods on a large-scale. The small plot trials are more accurate and provided detailed statistical analysis of the impact of different treatments. Further years of research and analysis from this site and other sites will confirm these findings.

References

Grains Research Development Corporation. (2009). Canola best practice management guide for south-eastern Australia. Melbourne: Coretext