Kirra Plains: Comparison of tillage methods for lime incorporation: YEAR 2

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Background

Until recently the most common rate of agricultural lime application is one tonne per hectare as a blanket application across the surface of the whole paddock (Taking soil acidity seriously, Gazey et al 2012). This amount is often insufficient to recover and maintain soils above recommended targets of pH 5.5 and 4.8 in topsoil and subsoil respectively. A 2015 phone survey of 20 growers, conducted by this project, found the majority of growers are now using 2t/ha in order to speed repair of soils.

As a result of the Caring for Country project SP11-01226, increasingly growers in WA are testing pH of soils below 10cm. Growers understand the importance of lime in restoring soil pH as seen by the increase in sales of lime in the northern wheatbelt (Liebe Group Technical Audit Results 2012.

Preliminary work by Davies (2012) has shown applicability of a number of innovative techniques, including mouldboard ploughing and rotary spading, for incorporation of lime to depth. Lime on the topsoil can be incorporated to a depth of 30 cm enabling management of pH at this depth (Developing and assessing agronomic strategies for water repellent soils, Davies 2012,).

This trial is one of six similar trials throughout the northern wheatbelt. It will help establish best practice methods and promote the effectiveness of these techniques throughout the rainfall zones of the NAR. This report covers two seasons of data, the initial incorporation of lime occurred in 2014.

Aim

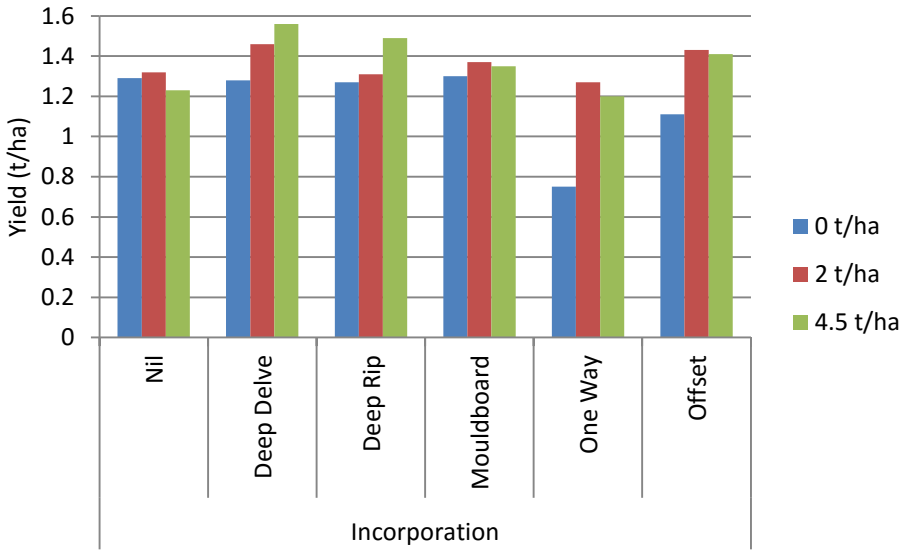
To showcase to growers different methods for deep incorporation of lime to ameliorate sub surface, below 10cm, acidity and improve soil health.

Trial details

Property	**Kirra Plains**
Soil type	**Yellow sandplain**
Crop / variety	**Wheat, Magenta**
Paddock rotation	**2013 Canola 2014 Wheat, Wheat 2015**
Treatments	**2014 Lime; 0, 2, 4.5 t/ha** **2014 Incorporation; Nil, offset disc, one way plough, mouldboard plough, deep rip, Grizzly Deep Digger®,**
Replicates	**2 reps**
Growing season rainfall, from DAFWA's Binnu weather station, 2015	**113mm Jan – Mar** **260mm April – September**

Results

Figure 1. Yield results of lime incorporation trial, with respective lime rates, Kirra Plains West Binnu 2015.



	Incorporation					
Lime	Nil	Deep Delve	Deep Rip	Mouldboard	One Way	Offset
0 t/ha	1.29	1.28	1.27	1.3	0.75	1.11
2 t/ha	1.32	1.46	1.31	1.37	1.27	1.43
4.5 t/ha	1.23	1.56	1.49	1.35	1.2	1.41

LSD

Lime	0.11
Incorp	0.51
Lime x Incorp	NS

Table 1. Tabled yield (t/ha) results of lime incorporation trial, Kirra Plains West Binnu 2015

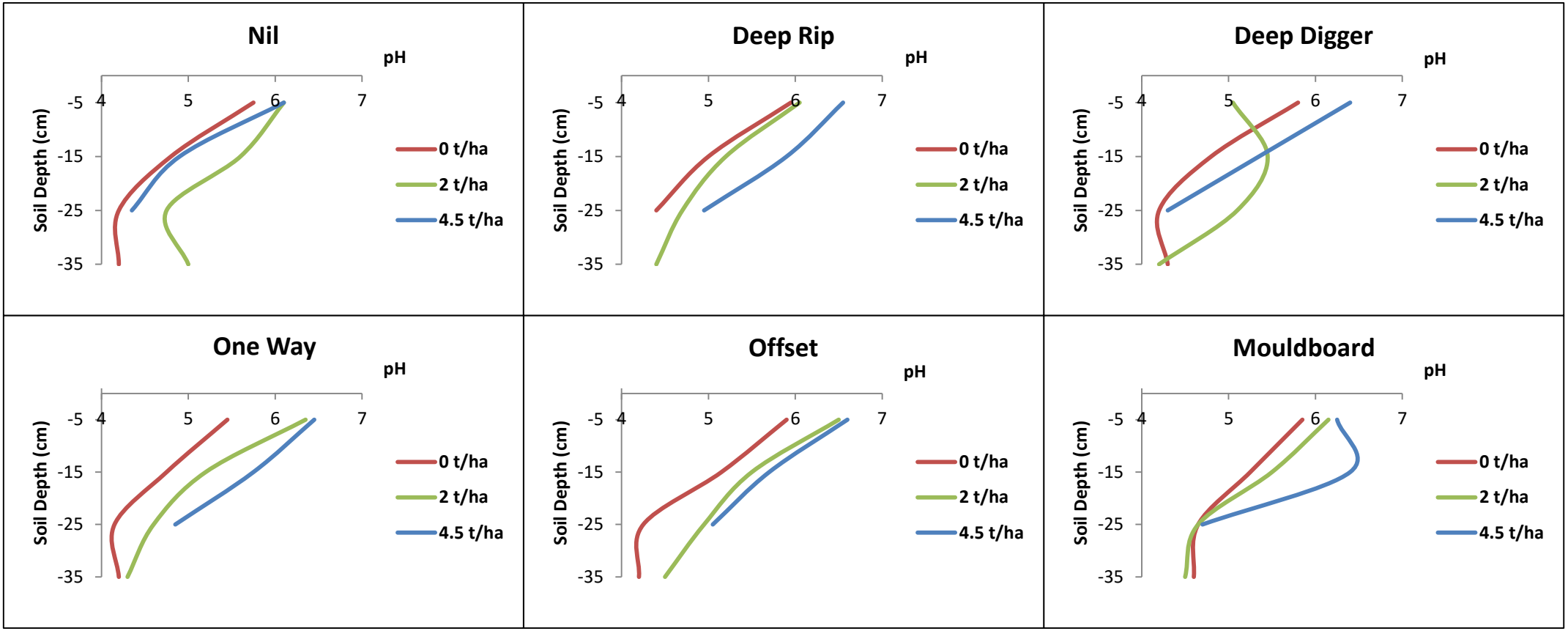
	Incorporation					
Lime	Nil	Deep Delve	Deep Rip	Mouldboard	One Way	Offset
0	6.76	6.86	6.29	8.3	8.06	7.88
2	7.04	5.56	6.68	7.62	7.86	7.25
4.5	5.81	4.95	6.73	6.09	8.06	7.15

LSD

Lime	NS
Incorp	1.38
Lime x Incorp	NS

Table 2. Percent (%) screenings from Kirra Plains 2015. Protein did not vary significantly between treatments, with an average of 11.2% across all treatments.

Figure 2. Graphical representation of the soil pH profile at Kirra Plains two seasons after incorporation of lime in 2015.



Comments

Prior to seeding in 2015 the trial paddock had generous coverage of melon vines.

28mm rainfall during all of August and September, a second wheat crop on the paddock, and late top up nitrogen all combined with a late frost event to decimate yield. The paddock had potential but the trial was only able to achieve a maximum yield of 1.5t/ha.

Plots without lime were consistently lower yielding than plots with lime irrespective of incorporation treatment. PH where lime hasn't been applied is below target at depth (Figure 2). This is one of the subsoil constraints that is impacting yield.

Treatments with incorporation tended to have higher yield than where lime is left on the surface.

Large lime application is lifting pH in the top 15cm, without incorporation.

The yield response to deep ripping was negligible this year at this site when compared to shallower or nil incorporation. There is insignificant difference when comparing yields of Deep Delver and deep ripper with nil incorporation. This is most likely the result of re-compaction of the profile. Unmanaged traffic paths were visible throughout the crop.

Deep ripping had little influence on pH at 2t/ha but significant where lime applied at 4.5t/ha. This influence is larger than anticipated. The deep ripper tines did not displace a large amount of soil, nor were they modified to hold open the slot for topsoil burial. It is possible that this result is from unrepresentative sampling at the time of soil collection. This under representation is also present in the results from the Grizzly Deep Digger.

Deep Digger surface pH results, lime at 2t/ha, are lower than the nil treatment. The Grizzly Deep Digger has curved 'C' tines that delve subsurface soil to the surface. This has decreased the surface pH in the vicinity of the tines. Sampling in this area will heavily influence pH results for this treatment.

In spite of the pH results Deep Delver incorporation tended to have the highest yield of all of the incorporation treatments. In 2014 the Deep Delver improved root access to moisture deeper in the profile. This appears to have had an influence in 2015 though no measurements of soil moisture have been taken. Further indication that soil compaction is present at the site and limiting yield of non-ripped treatments.

In 2015 the one way plough has decreased yield and increased screenings when compared to nil incorporation.

Notes from 2014

The Grizzly Deep Digger was able to incorporate lime and organic matter to a depth of 25cm, though determining the true surface of the soil is challenging after such aggressive disturbance (Figure 3). All paddock management was impacted by the extra deep ripping. Seeding depth was variable, spraying and harvest speeds were reduced. Large depressions were left in the soil with tractor traffic. All of these adding argument to the value of controlled traffic pathways.

The texture and moisture of the soil play a large part in the outcome of mouldboard ploughing (Figure 4). At this site the sandy topsoil was dry during mouldboarding. As a result a full inversion of the soil was not completed. The topsoil tumbled down the plough

Shear mixing the lime sand throughout the 25cm depth of ploughing. Only small seams of acidic subsurface were brought to the surface.

Both offset discs (Figure 5) and one way plough were able to work lime into their respective working depths. At this site 15cm incorporation was the limit of mixing for both of these implements.

The deep ripper* was able to incorporate lime to approximately 18cm. The seam of lime incorporated was only approximately 2cm per tine which represents only a small volume of the total soil profile.

Incorporation treatments mouldboard, deep rip and deep delve improved root access to moisture at depth. Soil moisture immediately prior to harvest was observed at 30cm beneath mouldboard and deep rip treatments and 40cm beneath deep delve treatments. This compares to moisture at 20cm below one way plough, offsets and nil incorporation treatments.

One of the take home messages from this trial is that sowing setup remains the weakest link when using deep tillage. Depth of sowing is critical and difficult to control on ameliorated soils. In this trial seeding bar floatation was poor on Deep Digger and mouldboard treatments. As a result it reduced the plant emergence and density though variable seed placement. A good establishment density is critical as for reducing erosion potential at both ends of the season.

[8]Note: Only photos with clear visual messages have been included in this report.

Funder, project code and project title

NACC, INNOV – 292, Demonstrating principals of ameliorating sub-surface pH to improve soil health

Figure 3. The Deep Digger is capable of incorporating lime and organic matter to approximately 25cm, West Binnu, image from 2014.

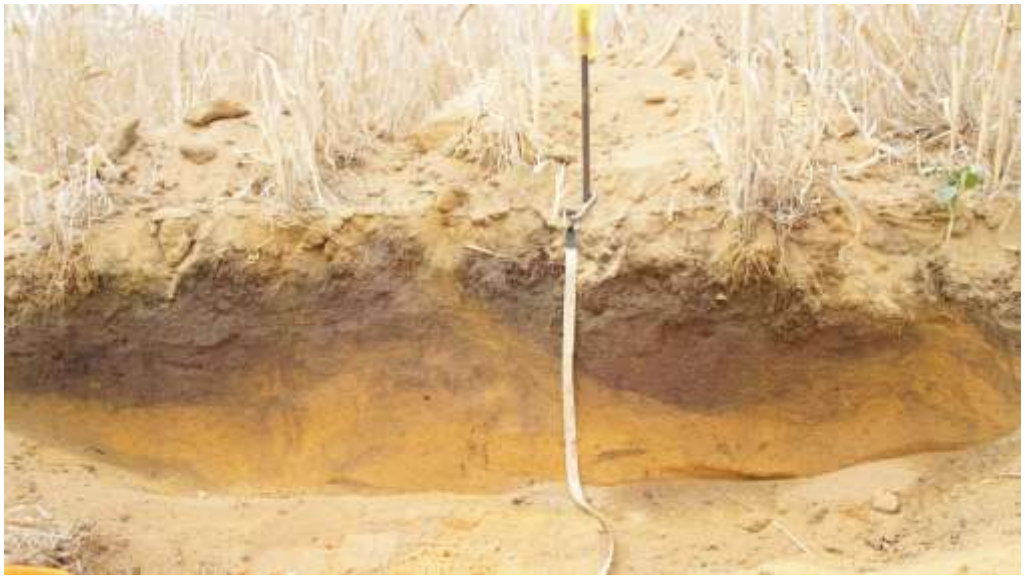


Figure 4. Loose, dry topsoil during the mouldboard operation has mixed lime through 25cm though inversion was poor, West Binnu, image from 2014.

Figure 5. Lime incorporated to working depth of 15cm with offset discs, West Binnu, image from 2014.

Links to further research on lime incorportation completeded by DAFWA in our region in 2015

- West Binnu (Kirra Plains) and Carnamah (combined with Year 1 West Gutha results) https://www.agric.wa.gov.au/soil-acidity/comparison-tillage-methods-lime-incorporation-2015-trial-report
- Tardun https://www.agric.wa.gov.au/soil-acidity/comparison-tillage-methods-lime-incorporation-tardun-2015-trial-report
- East Yuna https://www.agric.wa.gov.au/soil-acidity/lime-incorporation-poor-performing-acidic-soil-patches-within-paddock-east-yuna-2015
- Latham https://www.agric.wa.gov.au/soil-acidity/comparison-tillage-methods-lime-incorporation-latham-2015-trial-report
- Bowgada https://www.agric.wa.gov.au/soil-acidity/comparison-tillage-methods-incorporation-lime-low-rainfall-zone-bowgada-2015-trial

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