Comparison of tillage methods for lime incorporation

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Aim

Using tillage to incorporate lime improves the rates of reaction and increases sub surface pH sooner than spreading lime on the surface alone.

Background

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.

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 NAR (Liebe Group Technical Audit Results 2012). However, according to Gazey and Andrew (Effective management of soil acidity, 2012) lime sales in 2012 of 1.1 million tonnes are still less than half that of the 2.5 million ton required per year, indicating low adoption of the recommended practice.

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 work will help establish best practice methods and promote the effectiveness of these techniques throughout the rainfall zones of the NAR.

Aim

To showcase to growers different innovative practices for deep incorporation of lime to ameliorate sub surface acidity and improve soil health.

Trial details

Property	**Kirra Plain**
Soil type	**Yellow sandplain**
Crop / variety	**Wheat, Callingiri**
Paddock rotation	**2013 Canola**
Treatments	**Lime; 0, 2, 4.5 t/ha** **Incorporation; Nil, offset disc, one way plough, mouldboard plough, deep rip, Grizzly Deep Digger®,**
Replicates	**3 reps**

Results

Figure 1. Results of lime incorporation trial, Kirra Plains West Binnu.

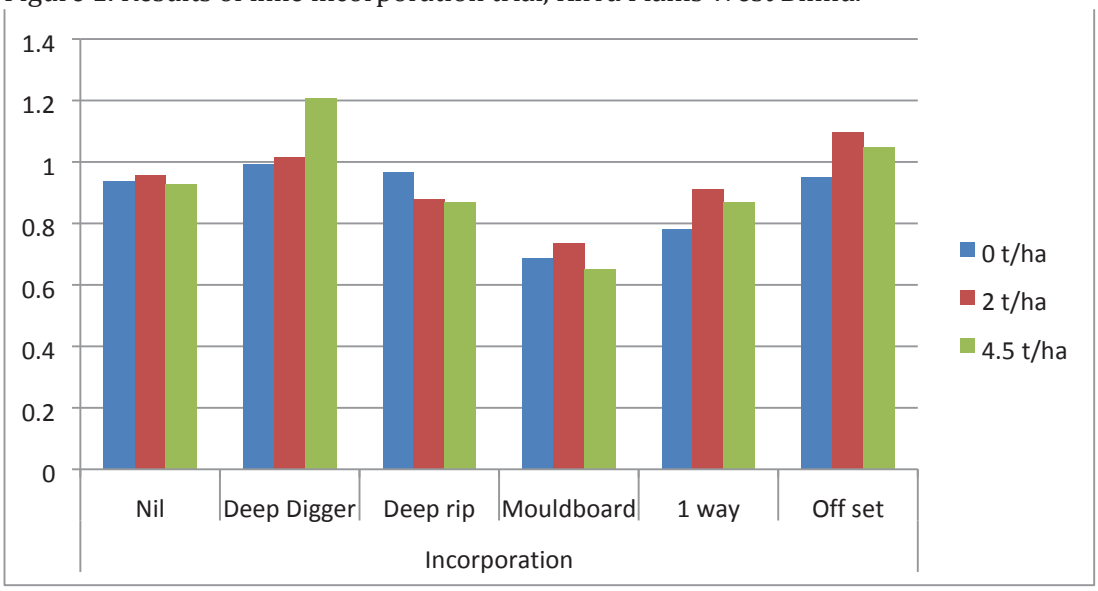

Table 1. Tabled results of lime incorporation trial, Kirra Plains West Binnu

Yield	Incorporation					
Lime	Nil	Deep delve	Deep rip	Mouldboard	1 way	Off set
0 t/ha	0.94	0.99	0.97	0.69	0.78	0.95
2 t/ha	0.96	1.01	0.88	0.73	0.91	1.10
4.5 t/ha	0.93	1.21	0.87	0.65	0.87	1.05

LSD	
Lime	NS
Incorp.	0.08
Lime x Incorp.	NS

Table 2. Protein analysis results from Kirra Plains West Binnu.

	Incorporation					
Lime	Nil	Deep delve	Deep rip	Mouldboard	1 way	Offset
0	14.6	14.2	14.6	16.5	15.2	15.4
2	14.1	15.1	14.9	16.6	14.5	14.2
4.5	14.9	13.9	14.6	16.1	14.4	14

LSD	
Lime	NS
Incorporation	0.5
Lime x incorp	NS

Comments

Plant emergence was greatest in the offset disc treatments and lowest in the mouldboard plough treatments. All treatments suffered yield loss through the hot, dry periods of July and August irrespective of plant density.

Without any incorporation lime remains in the surface soil, approximately 10cm, the working depth of the seeding bar*.

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. 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 2). 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 4) 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 tyne 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.

Acknowledgements

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Further information on this and two other trials can be found at this website;
https://agric.wa.gov.au/n/3815

Trial images

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

Figure 2. The Deep Digger is capable of incorporating lime and organic matter to approximately 25cm, West Binnu. Showing the incorporation of lime and organic matter of the Deep digger and the resulting compaction by traffic on the loose soil.

Figure 3. Loose, dry topsoil during the mouldboard operation has mixed lime through 25cm though inversion was poor, West Binnu.

Figure 4. Lime incorporated to working depth of 15cm with offset discs, West Binnu. Note the wave pattern left by the incorporation of lime with offset discs.