Deep Ripping & Deep Placement of Lime

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Aim To improve grain production by ameliorating subsurface compaction and subsurface acidity.

Background

This trial was established as part of a GRDC funded subsurface acidity project, **'Development of new methodologies to treat subsurface acidity'**. The site was selected as a poorer performing area paddock with low pH in the subsurface. The major constraints to production at this site are subsurface acidity and compaction. In WA soils, subsurface acidity results in aluminum toxicity often occurring in the 10-35cm zone of soil. This is also the depth where a physical hardpan often occurs in sandplain soils. This project aims to develop methods to deep banding lime to treat subsurface acidity whilst also ameliorating soil compaction. Lime, delivered from a modified airseeder bin was placed into the soil profile via delivery boots attached to the tynes of a deep ripper. An Agrowplow shallow leading tyne (SLT) deep ripper fitted to an airseeder bin was used in this trial to simultaneously deep rip to 30cm and place a total of 2.5 t/ha of lime sand distributed at 10, 20 and 30cm or to place a total of 5 t/ha 10, 20 and 30cm and 30, 40 and 50 cm depth intervals. Treatments to control for the disturbance of deep ripping were also applied.

Trial Details

Property	Brian McAlpine West Maya
Plot size & replication	40m x 1.8 x 4 replicates
Soil type	Acidic deep yellow sand
Sowing date	18th May 2005
Seeding rate	60 kg/ha Calingiri
Fertiliser (kg/ha)	100 kg/ha of K-Till Xtra (CSBP product) at seeding. 50 L/ha Flexi N on 20th June and additional 40 L/ha FlexiN on 26th July
Paddock rotation	2004 = Canola, 2003 = Wheat, 2002 = Brown Manure Lupins
Growing Season Rainfall	298.5mm for 1 April - end October and total year rainfall of 325.5mm

Results There was no response to either the surface or deep applied lime in the first year of this trial. This result is consistent with many ripping and deep lime placement trials. There was an early plant response to deep ripping to 30cm and a larger response to the additional ripping treatment to 50cm (Table 1). The plant biomass response to the deep ripping at this site was probably due to an interaction between the hardpan and the mid-season dry spell.

The response in biomass for the treatments deep ripped to 50cm carried through into the yield where the two treatments yielded approximately 0.8 t/ha more than the unripped control. There was a trend in the treatments that were ripped to 30cm, which yielded between 0.2 and 0.4 t/ha more than the control.

Table 1: Biomass and Yield of Calingiri with and without ripping and lime.

Treatment	**Biomass (t/ha) 19/9/05**	**Yield (t/ha)**
Control, no rip, no lime	4.04ab	2.5ab
Deep Rip @ 10, 20 & 30cm	4.62b	2.9ab
Deep Rip @ 10, 20 & 30cm injecting 2.5 t/ha lime	4.58b	2.9ab
Lime distributed by machine on surface @ 2.5 t/ha and DR	4.53b	2.7ab
Lime distributed by machine on surface only	3.78a	2.4a
Deep Rip @ 10, 20 & 30cm injecting lime @ 2.5 t/ha, DR again @ 30, 40 & 50 cm, injecting lime @ 2.5 t/ha	5.55c	3.3c
Deep Rip @ 10, 20 & 30cm, no lime, DR again @ 30,	5.38c	3.3c

40 & 50 cm, no lime		
LSD	0.68	0.4

The location of lime incorporated via the deep ripping tynes was determined by sampling a face perpendicular to the direction of the ripping. The machinery successfully incorporated lime in seam to 30cm and increased the pH between 1 to 3 units, there was also a corresponding decrease in the level of Al measured, an example is given in Table 2. The distance between the tynes in this trial was 450mm, while this appeared to be appropriate for treating the hardpan it is likely not enough of the soil profile was treated by the lime to have a significant effect.

Table 2: Soil pH and Al levels on a grid face, each value represents a block of soil 5cm x 5cm. The lime was incorporated to 30cm in column C.

	pH (Calcium Chloride)					Al (Calcium Chloride) ppm			
Depth (cm)	A	B	C	D		A	B	C	D
0-5	4.7	6	5.5	4.6		2	0.5	1	2
5-10	4.1	4.2	5.4	5.4		6	6	0.5	0.5
10-15	4	4	4.7	6.4		9	12	2	0.5
15-20	4.2	4	6.5	4.7		11	16	1	2
20-25	4.1	4	4.3	4		14	16	7	16
25-30	4	4	4.2	4		16	16	13	16
30-35	4	4	7.4	4.1		16	16	1	15
35-40	4	4	4	4		16	16	16	15
40-45	4	4	4	4		15	16	15	16
45-50	4	4	4	4		16	16	16	16

Current recommendations aim for a surface soil (0-10cm) pH above 5.5 and a subsurface soil around 5. These recommendations are designed to have a surface soil high enough in pH so that there can be leaching and treatment of subsurface soil acidity from the surface and also so that the subsurface soil remains above pH 4.5 where Al levels become toxic to plant roots.

COMMENTS

This work has demonstrated that it is possible to incorporate lime into seams in the soil profile which can increase the soil pH and decrease the levels of toxic Aluminium. At present it is not practical with existing farm machinery. However, precision agriculture and tramline farming techniques do provide opportunities to place lime and nutrients more precisely in the future and gradually ameliorate more of the soil profile. A better method of mixing the lime is required as concentrating lime to raise the pH to 7.4 in one area as indicated in Table 2 is inefficient.

Farmers are encouraged to carry out soil testing to at least 20cm and preferably to 30cm on sandy soils to understand their soil pH profile. This will assist in making the correct liming decision to treat subsurface acidity.

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