DEEP RIPPING AND DEEP PLACEMENT OF LIME

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AIM

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

BACKGROUND

This trial is a satellite site of the Liebe Group's GRDC funded soil health project, **'A sustainable dryland community achieved through proactive research on effective management of the soil resource'**. The site was selected as a poorer performing paddock and since 2003 has been benchmarked for soil quality parameters. The site is a typical 'wodjil' soil and in addition to the inherent subsurface acidity, compaction was also identified as a major constraint to production. 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. Deep banding lime is one management practice that is currently being evaluated to determine how well it can improve subsurface acidity whilst also ameliorating soil compaction. Lime, delivered from a modified airseeder bin or belt spreader, is 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 depth intervals.

TRIAL DETAILS

Property	Brian McCreery, Kalannie
Plot size & replication	3.0m x 41m x 3 replicates
Soil type	**Deep acidic wodjil sand**
Sowing date	23rd May 2005
Seeding rate	65 kg/ha Arrino
Fertiliser (kg/ha)	70 kg/ha DAPSCZ, 50 kg/ha Urea, 25 kg/ha MOP
Paddock rotation	2004 = Pasture, 2003 = Wheat
Herbicides	**1 L/ha Roundup Powermax, 500 mL/ha MCPA LVE + 7g Logran**
Growing Season Rainfall	207.5mm (Kalannie weather station)

Results Grain yield was significantly increased with all deep-ripping treatments. Deep ripping to 30cm increased yield by 44% compared to the unripped treatment. Grain samples were obtained from only one replicate within the trial and thus only represent a small sample size. However, it appears that despite overall screenings being high, all deep ripped treatments seem to have reduced the level of screenings, most likely through increased access of plant roots to stored soil moisture. Figure 1 illustrates soil resistance of a control and deep ripped treatment.

The deep ripped treatment clearly shows that the compaction layer has been removed to the depth of ripping (30cm) and is below the 2500 kPa threshold at which root growth can become restricted.

Deep ripping to 30cm was the only treatment to return a positive gross margin of $28/ha in 2006. Due to high screenings all treatments only made ASW grade. High screenings and low yield, due to a combination of low rainfall and subsurface acidity, together with low commodity prices highlight the challenges of successfully farming the wodjil soils of the northeastern wheatbelt. Estimated gross margins were calculated on an ASW price of $176t FOB as of the week of 1st December 2005. Estimated gross margins were calculated using full variable costs as per Farm Budget Guide 2005 and actual input costs. The full cost of deep ripping and lime

application was included into these gross margins, however it must be remembered that the benefits of these practices will be obtained over a number of years.

Table 1: Yield, grain quality and gross margins of Arrino in response to deep ripping and lime treatments.

Treatment	Yield (t/ha)	Biomass at anthesis (t/ha) (t/ha)	Protein (%)	Hectolitre (g)	Screenings (%)	Gross Margin ($/ha)
1. Control	1.21 b	4.76	11.7	75.20	9.64	- 10
2. Deep ripped to 30cm	1.74 a	6.58	11.4	74.42	8.92	28
3. Deep ripped + lime injected at 10,20 &30cm at total of 2.5 t/ha	1.75 a	5.70	12.6	73.17	7.34	- 11
4. Lime spread on surface at 2.5 t/ha then deep ripped to 30cm	1.80 a	6.16	11.6	78.44	8.20	- 12
5. Lime spread on surface at 2.5 t/ha	1.22 b	4.28	11.5	76.71	7.28	- 53
LSD (5%)	0.13	-	-	-	-	-

Means followed by the same letter do not significantly differ

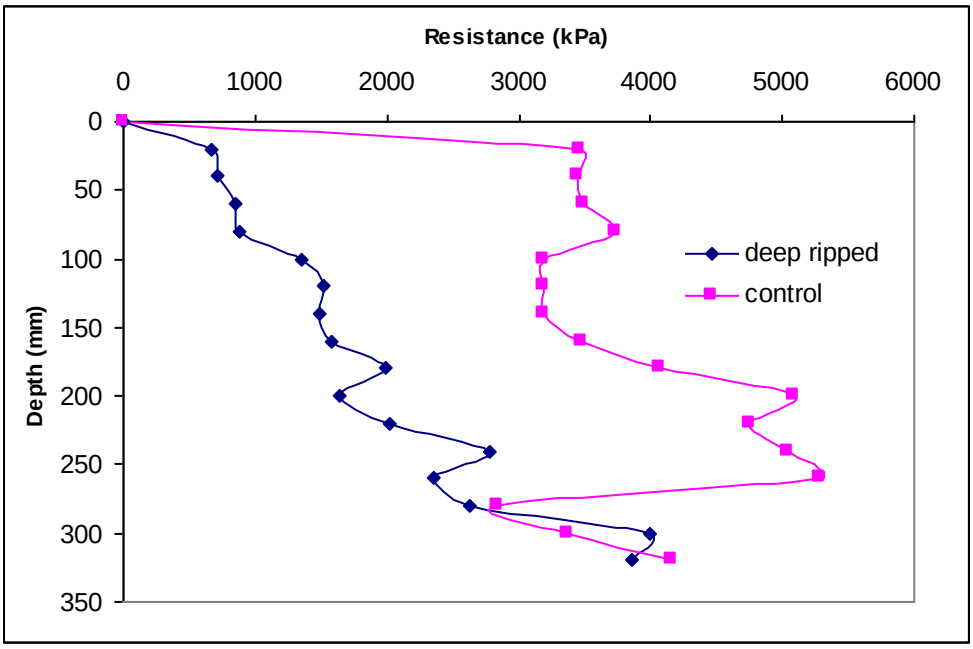

Figure 1: Soil compaction as measured with Penetrometer to 600mm. Root growth can be hindered above 2500 kPa.

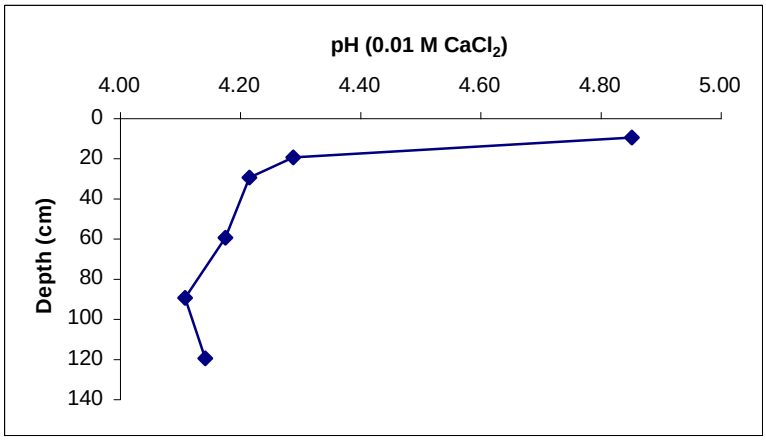

Figure 2: Soil pH, measured in calcium chloride in 2003 of control.

There was no significant response to lime application either top-dressed or deep banded. This was not unexpected as obtaining yield improvements by increasing soil pH is a long-term process. Figure 2 shows the pH profile of the untreated control as sampled in 2003. Topsoil pH is acidic at about 4.8 however the soil becomes strongly acidic at pH 4.1 at 90cm. It is very likely that pH is constraining yield. The concentration of Aluminum ions in the soil solution increases as the pH decreases below 5.0. Aluminum can then become increasingly toxic to plant roots. Restricted root growth means that plants are not able to access the full volume of soil and thus access valuable nutrients and water. This trial will be monitored over the coming years to determine the response to lime application.

COMMENTS

- Removal of soil compaction via deep ripping to 30cm resulted in 44% yield increase which equated to a gross margin of $38/ha more than the untreated control.
- Addition of lime did not significantly improve yield in 2006 however it is possible that a response will be gained in future years as subsurface acidity is present in the soil profile.

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