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 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. 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 McAlpine, West Maya**
Plot size & replication	736m x 11.7m x 2 replicates
Soil type	Sand over gravel grading into deeper sand
Sowing date	14th May 2005
Seeding rate	93 kg/ha Calingiri
Fertiliser (kg/ha)	14th May 2005: 100 kg/ha K-Till Extra 13th June 2005: 60 L/ha Flexi N 25th July 2005: 40 L/ha Flexi N
Paddock rotation	2004 = Lupin, 2003 = Wheat, 2002 = Wheat
Herbicides	**34.7 g/ha Logran + 867 mL/ha SpraySeed + 1.2 L/ha Trifluralin (13/5).** 474 mL/ha MCPA LVE + 4.7 g/ha Chlorsulfuron (13/6).
Growing Season Rainfall	298.5mm

Results Grain yield was significantly increased with the deep ripping treatments. Deep ripping to 30cm with the Gessner deep ripper increased yield by 19% compared to the unripped treatment. There was no significant yield difference between the rip only treatment using the Gessner ripper to the rip + 2.5 t/ha of lime sand using the SLT deep ripper. Figure 1 illustrates soil resistance of the control treatments compared to the deep ripped plots of the Gessner ripper and the SLT ripper. The deep ripped treatments clearly show that the compaction layer has been removed to the depth of ripping and is below the 2500 kPa threshold at which root growth can become restricted.

Deep ripping to 30cm with the Gessner ripper provided the best gross margin of $191/ha, which was a $40 /ha improvement over the unripped treatment. Grain from all treatments failed to make ASWN due to low protein and there were no other significant differences in grain quality between treatments. Gross margins are based on an EPR 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 approximate gross margins of Calingiri in response to deep ripping and lime treatments.

Treatment	Yield (t/ha)	Biomass at anthesis (t/ha)	Protein (%)	Hectolitre (g)	Screenings (%)	Gross Margin ($/ha)
1. Control	2.72 b	5.93 b	9.17 a	81.95 a	0.73 a	151
2. Deep ripped to 30cm with Gessner Deep ripper	3.23 a	7.40 a	9.30 a	82.29 a	0.66 a	191
3. Deep ripped + lime injected at 10,20 &30cm at total of 2.5 t/ha with SLT ripper	3.16 a	7.50 a	9.10 a	81.98 a	0.67 a	132
LSD (5%)	0.17	1.43	0.21	0.58	0.16	-

Means followed by the same letter do not significantly differ.

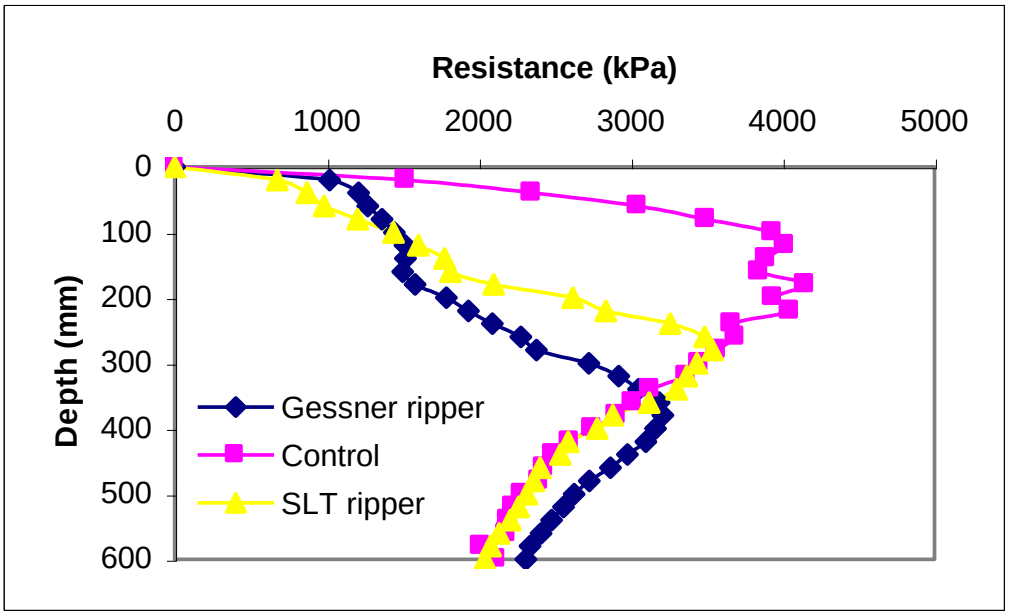

Figure 1: Soil compaction as measured with Penetrometer to 600mm. Root growth can be hindered above 2500 kPa.

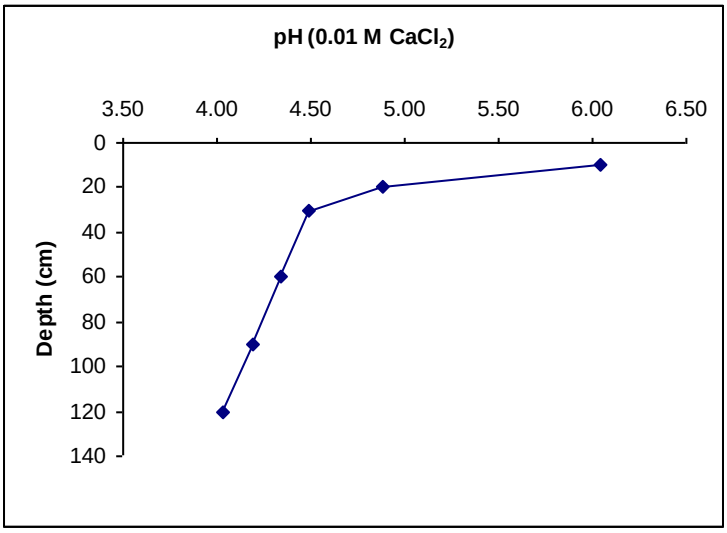

Figure 2: Soil pH, measured in calcium chloride in 2003 of control.

There was no significant yield response to deep-banded limesand in this trial. This was not unexpected as obtaining yield improvements by increasing soil pH is generally a long-term process. Figure 2 shows the pH profile of the untreated control as sampled in 2003. This paddock does have a history of topsoil liming with 0-10cm pH at about 6.0. However the soil profile becomes increasingly acidic with pH 4.5 at 20-30cm and strongly acidic at pH 4.0 at 90cm. It is likely that pH is affecting root growth at 20-30cm. 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 resulted in 19% yield increase and $65/ha improvement over 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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