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 have been identified as subsurface acidity and soil 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	Tony & Karolyn Mason, Perenjori
Plot size & replication	3m x 60m x 3 replicates
Soil type	Sand – loamy sand
Sowing date	2nd May 2005
Seeding rate	70 kg/ha Stirling Barley
Fertiliser (kg/ha)	70 kg/ha Multiyield, 100 kg/ha Gransulam
Paddock rotation	Wheat = 2004, Wheat = 2003, Pasture = 2002
Herbicides	1.2 L/ha Roundup Powermax, 1.8 L/ha Trifluralin, 800 mL/ha MCPA LVE
Growing Season Rainfall	258.9mm (Perenjori weather station)

Results Grain yield was significantly increased with the deep ripping treatments. Deep ripping to 30cm increased yield by 15% over the unripped treatment. Figure 1 illustrates soil resistance of a control and deep ripped treatment. Resistance of the control treatment exceeds 3500 kPa at 100mm and the graph line is not plotted to 600mm as soil resistance exceeded the maximum threshold of pressure for the Penetrometer. 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 also provided the best gross margin of $203/ha compared to all other treatments in 2006. All treatments made malt grade based on protein however some treatments had hectolitre weights below the malt standard of 64g. Grain quality results were obtained from only one replicate within the trial and thus only represent a small sample size. Gross margins were therefore calculated assuming all treatments made malt and are based on Stirling malt EPR price of $190t FOB as of the week of the 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.

Treatment 6 and 7, deep ripping with plus or minus 5 t/ha lime in two passes is an experimental treatment. It is not considered to be of practical application however was included to determine if there is a response to a large amount of lime and to a greater depth of deep ripping.

Table 1: Yield, grain quality and gross margins of Stirling Barley 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	2.23 ef	3.62 b	10.42	64.69	2.64	177
2. Deep ripped to 30cm	2.56 ab	3.93 ab	11.08	63.74	3.11	203
3. Deep ripped + lime injected at 10,20 &30cm at total of 2.5 t/ha	2.58 a	3.97 ab	11.22	66.92	3.13	151
4. Lime spread on surface at 2.5 t/ha then deep ripped to 30cm	2.54 abc	3.86 ab	11.59	65.06	3.17	145
5. Lime spread on surface at 2.5 t/ha	2.19 f	3.63 b	10.90	62.10	2.97	117
6. Deep ripped + lime injected at 10,20 &30cm at 2.5 t/ha then Deep ripped + lime injected at 30,40 & 50cm at 2.5 t/ha for total of 5 t/ha.	2.50 abcd	4.11 a	10.82	61.52	3.13	74
7. Deep ripped to 30cm then Deep ripped to 50cm	2.46 abcde	3.74 ab	11.07	63.14	3.72	177
LSD (5%)	0.25	0.40	-	-	-	-

Means followed by the same letter do not significantly differ.

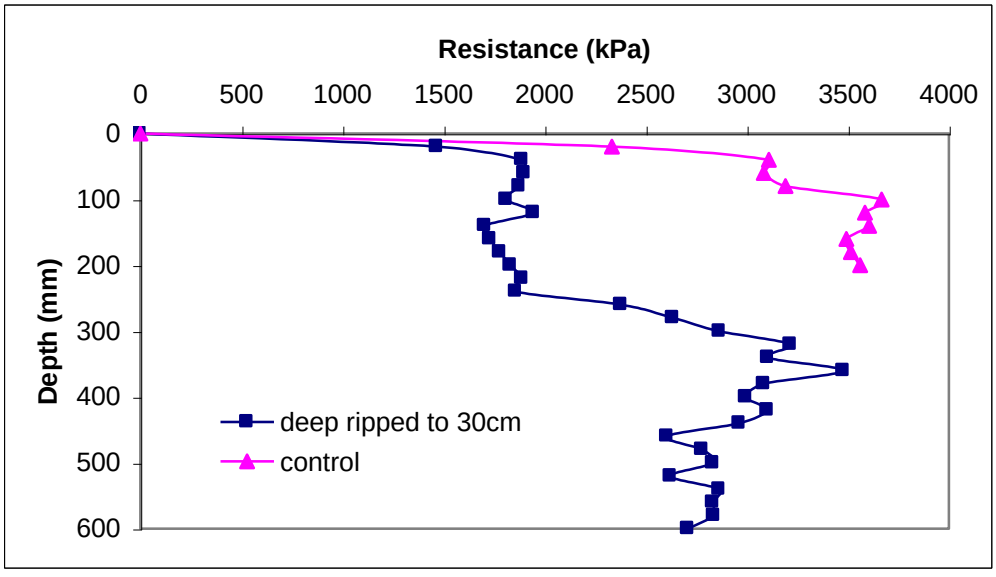

Figure 1: Soil compaction as measured with Penetrometer to 600mm. Root growth can be hindered above 2500 kPa.

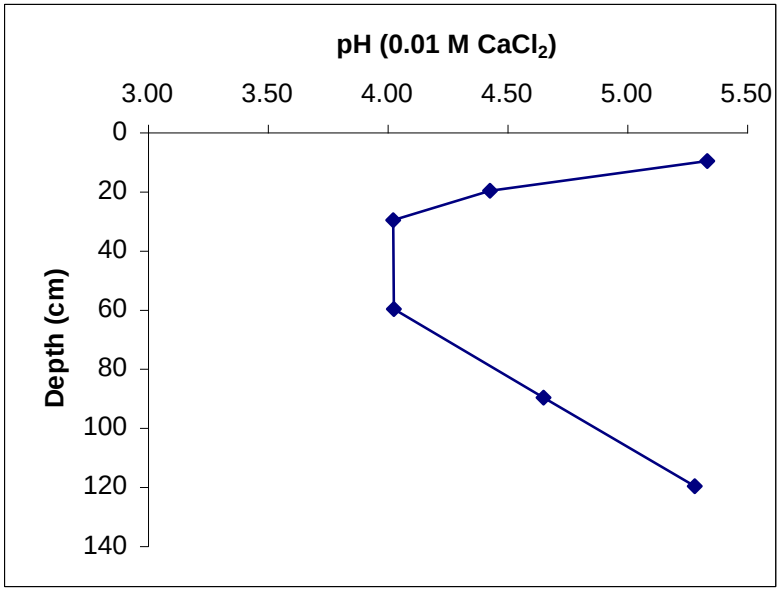

Figure 2: Soil pH, measured in calcium chloride in 2003 of control.

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. This paddock does have a history of topsoil liming with 1.5 t/ha limesand in 1995. Topsoil pH is marginally satisfactory at 5.3 however the soil becomes very acidic at pH 4.0 at 20-30cm. It is 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 15% yield increase which equated to a gross margin of $26/ha more than 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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