Evaluation of Spading x Lime incorporation in low pH, non-wetting sand

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Aim

To examine whether deep cultivation by spading can be used to manage water repellence and subsoil acidity on sandplain soil.

Background

This demonstration was established in 2010 to assess the impact of a one-off deep soil cultivation using a rotary spader to dilute water repellent soils and ameliorate subsurface acidity through the incorporation of lime.

The trial was spaded in May 2010 to a depth of 30cm. The 'spade' on rotary spader tynes can carry topsoil down into the subsoil and also bring subsoil up to the surface, mixing to a depth of 25-30cm. It is estimated that the rotary spader buries at least two-thirds of the topsoil with the remaining one-third left in the topsoil.

In 2010 the spading was successful in diluting the water repellent soil but did not increase the yield of the lupin crop due to poor establishment as a result of being sown too deep, exacerbated by furrow infill.

Water repellence in soils is caused by waxes from plant residues which coat the sand particles. These waxes are hydrophobic and can cause slow and uneven infiltration of water into the soil. The mixing action of a spader reduces water repellence in sandy soils by diluting the organic matter-rich repellent topsoil through the top 30cm of the soil profile and by lifting seams of subsoil to the surface that can act as preferred pathways for water movement. As a consequence of the mixing action, some of the topsoil can remain slightly water repellent after spading. The fate of the buried water repellent topsoil is not yet known, and there is a risk that cultivation of this type may ultimately increase the depth of non-wetting. However, it is suggested that over time the buried non-wetting topsoil will become wettable once the waxes causing repellence have been degraded by micro-organisms.

Surface applied lime can take over half a decade or more to significantly increase the subsoil pH below
10cm unless the lime is incorporated. Spaders can effectively incorporate surface applied lime into acid subsoils to depths of up to 30-35cm thereby significantly speeding up the amelioration of subsoil acidity.

Trial Details

Property	Hunt Partners, Marchagee	
Plot size & replication	22.5m x 1,000m, not replicated	
Soil type	Deep pale yellow sand	
Soil pH ($CaCl_2$)	0-10cm: 5.7-6.3	10-30cm: 4.3-4.5
EC	0.02 dS/m	
Sowing date	20/6/12	
Seeding rate	70 kg/ha Magenta	
Fertiliser	20/6/12: 80 kg/ha K-Till extra, 60 L/ha Flexi-N banded 26/7/12: 30 L/ha Flexi-N	
Paddock rotation	2009 wheat, 2010 lupins, 2011 wheat	

Herbicides	14/6/12: 2 L/ha Glyphosate 450 20/6/12: 1 L/ha Sprayseed, 2 L/ha Treflan, 25 g/ha Monza 22/7/12: 750 mL/ha Jaguar, 500 mL/ha MCPA LVE, 5 g/ha Metsulfuron 25/10/12: 2 L/ha Glyphosate
Growing Season Rainfall	175mm

Results

The 'spade' on rotary spader tynes, mixes soil to a depth of 25-30cm allowing the opportunity for mixing lime if pH is a problem. In Figure 1 a bulge in soil pH can be seen in the sub soil where surface applied lime and dolomite lime was incorporated. This bulge corresponds with the maximum working depth of the spader.

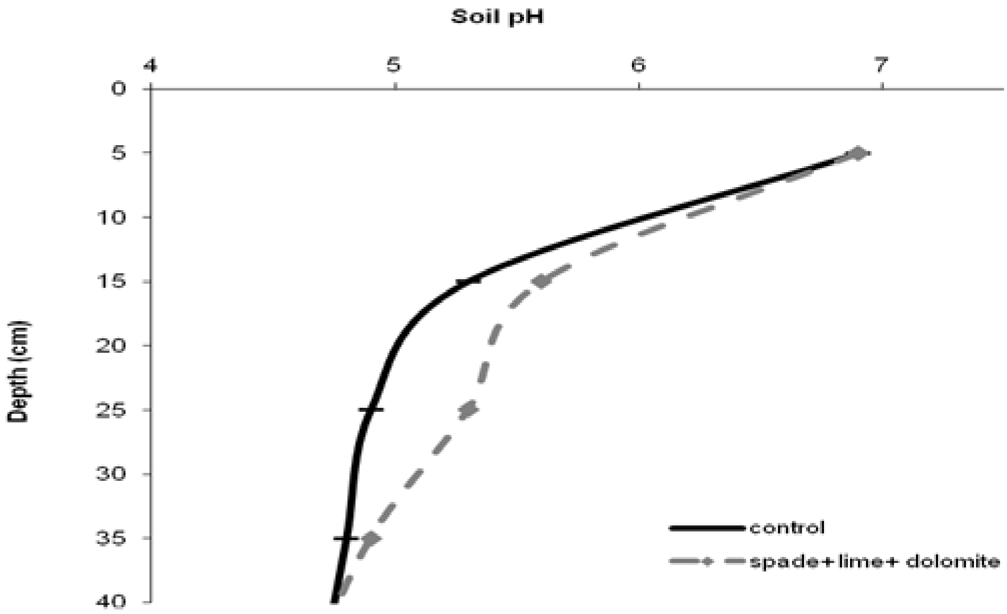

Figure 1: Soil pH ($CaCl_2$) profile changes as a result of spading and incorporating lime and dolomite, measured in April 2012.

Table 1: Wheat yield for 2011 and 2012 and lupin yield in 2010 using a rotary spader or deep ripper to cultivate soil at Marchagee. Soil was cultivated in April 2010.

Treatment **Crop**	**2012 Yield (t/ha)** **Wheat**	**2011 Yield (t/ha)** **Wheat**	**2010 Yield (t/ha)** **Lupins**
Control (No tillage)	0.8	1.3	0.7
Deep Rip	1.0	1.4	0.7
Spade	1.0	1.5	0.5
Spade+ Lime (1 t/ha)+ Dolomite (1 t/ha)	1.2	1.7	0.5

The crop yields which have been collected from the last 3 seasons are shown in Table 1 and Figure 2. In 2010, the year the spading was conducted, spading caused yields to decrease compared to the control because the lupins were sown too deep and sand-blasted due to the lack of soil cover, greatly reducing plant numbers. In 2011 and 2012 spading has increased yield by 0.2 t/ha and 0.1 t/ha respectively above the control, a similar response to deep ripping, indicating the spading response could be due to the removal of the compaction layer rather than the removal of the non-wetting soil. However, the farmer has observed improved infiltration of rainfall due to spading (measurements not presented). Using the spader to mix lime through the soil in an attempt to ameliorate soil acidity has improved yield beyond the initial gain of spading alone. The addition of lime and dolomite increased yield by an additional 0.2 t/ha compared to spading in both 2011 and 2012.

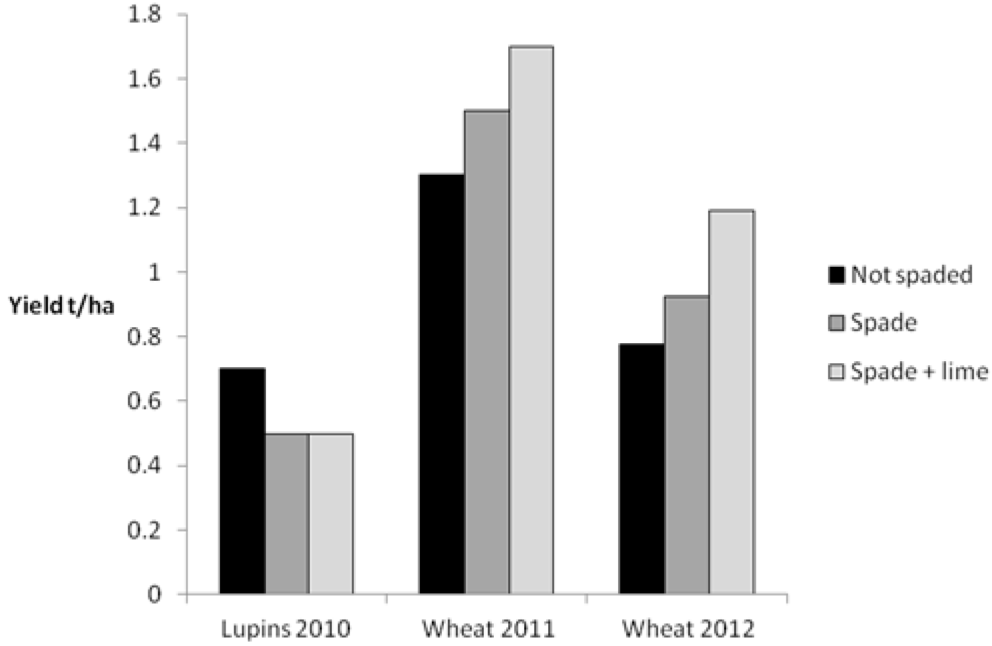

Figure 1: Crop yields after spading compared with no spading at Marchagee on pale sand. Spading was a once off occurrence in March 2010.

Comments

- Spading has mixed the non-wetting layer of soil in this paddock through the soil profile, resulting in an increase in crop yield in two out of past three years.
- Using the spader to mix lime and dolomite into the subsoil has improved the pH of the soil and increased yield.
- Wind erosion is a big risk with spading and caused a yield decrease in 2010, the year the spading occurred.
- Spading also reduces compaction at a similar level to deep ripping by physically breaking down any compacted layers in the top 30cm.
- Soil type is a large factor in the success of a spading operation; careful consideration must be given to this prior to commencing any spading program.

Acknowledgements
Stephen Davies involvement is supported by the 'Delivering Agronomic Strategies for Water Repellent Soils' DAW00204 and 'Putting PA on the ground in WA' CSA00016 GRDC projects.
Thanks to Clint, Ian Hunt and Simon Meyer for conducting the trial and GRDC for funding the work through LIE00006 'Improved stubble and soil management practices for sustainable farming systems in the Liebe area'.

Paper reviewed by: Chris O'Callaghan, Liebe Group

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