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

Nadine Hollamby, Project Coordinator, Liebe Group
Stephen Davies, Research Officer, DAFWA

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 burial of lime. 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 and furrow infill.

The trial was spaded in May 2010 to a depth of 30cm. The 'spade' on a 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 one-third remaining in the topsoil.

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 and repellent topsoil through the top 30cm of the soil profile and by creating subsoil seams in the topsoil 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 increase the depth of non-wetting. However, it is hoped 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 a decade to significantly increase the subsoil pH below 10cm unless 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 soil acidity.

Trial Details

Property	Hunt partners, Marchagee
Plot size & replication	22.5m x 1000m
Soil type	Deep yellow sand
Soil pH ($CaCl_2$)	Topsoil pH_{Ca} = 5.7-6.3; Subsurface (10-30cm) pH_{Ca} = 4.3-4.5
EC	0.02 dS/m
Sowing date	10/6/11
Seeding rate	70 kg/ha Wyalkatchem
Fertiliser	10/6/11: 80 kg/ha K-Till Extra, 80 L/ha Flexi-N 22/7/11: 30 L/ha Flexi-N

Paddock rotation	2008 lupins, 2009 wheat, 2010 lupins
Herbicides	10/6/11: 2 L/ha Glyphosate 450, 1 L/ha Paraquat, 1.5 L/ha Treflan 16/7/11: 1 L/ha Precept, 500 ml/ha MCPA LVE 18/8/11: 600mL/ha Jaguar, 500 ml/ha MCPA LVE
Insecticide	100 mL/ha Alpha Duo
Growing Season Rainfall	308mm

Results

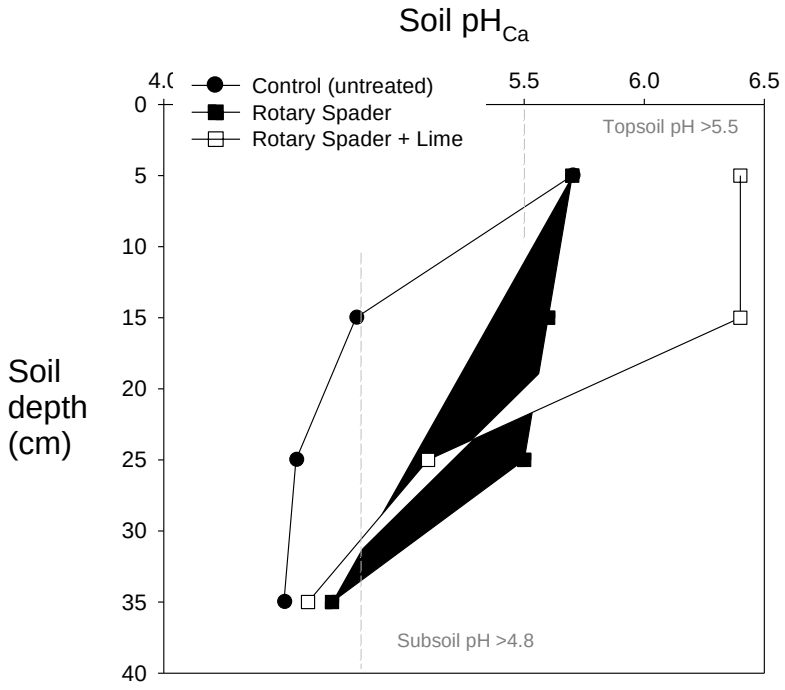

Figure 1: Soil pH ($CaCl_2$) profile changes as a result of spading and incorporating lime and dolomite, measured in 2010.

.

Table 1: Wheat yield for 2011 in the second season after using a rotary spader or deep ripper to cultivate soil at Marchagee. Soil was cultivated in April 2010.

Treatment	Yield (t/ha)
Control	1.3
Deep Rip	1.4
Spade	1.5
Spade+ Lime (1 t/ha)+ Dolomite (1 t/ha)	1.7

Comments

Subsoil pH at the site is acidic and with some samples as low as 4.3 with high levels of aluminium so the growth of sensitive crops may be reduced. Soil measurements taken in 2010 had indicated that subsoil pH was improved as a result spading alone due to the incorporation of higher pH topsoil and further improved with addition of lime and dolomite (Figure 1). There was a trend towards higher yield in response to spading alone in 2011 with a grain yield 200 kg/ha higher than the control. In addition there is also some evidence that the improvement in subsoil pH contributed to improved yield with the spading and lime being the highest yielding treatment, 200 kg/ha higher than spading alone. Given the

relatively high cost of spading $120-150/ha with additional costs for lime and dolomite further yield increases in subsequent years would be needed to make the soil amelioration efforts worthwhile.

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 Hunt Partners 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: Stephen Davies, DAFWA.

Contact:
Nadine Hollamby, Liebe Group
nadine@liebegroup.org.au
(08) 9661 0570