DEEP PLACED LIME INCREASES CROP YIELD IN A DRY SEASON

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AIM

To assess the capacity of surface applied and deep placed lime to improve subsoil pH and productivity of deep acid (Wodjil) sand.

BACKGROUND

The site was established in 2005 as part of the Liebe Group soil health project. Deep ripping and deep placed lime treatments were applied using a shallow leading tyne ripper with 45cm tyne spacings. Lime treatments were either placed on the surface only, placed on the surface and then deep ripped to aid incorporation or placed directly into the subsoil behind the tynes of the deep ripper (see treatment list Table 1).

TRIAL DETAILS

Property	Colin Bryant, Latham
Plot size & replication	60m x 3m x 3 replicates
Soil type	Wodjil
Sowing date	11/5/07
Seeding rate	70 kg/ha Calingiri wheat
Fertiliser (kg/ha)	11/5/07: 50 kg/ha DAPSZ 11/5/07: 300 mL/ha Customer Formulated Fertiliser
Paddock rotation	2004 = Lupin; 2005 = Wheat; 2006 = Pasture
Herbicides	1.5 L/ha Trifluralin; 220 g/ha Diuron; 20 g/ha Logran; 500 mL/ha LVE MCPA; Logran 5 g/ha + Ally 4 g/ha + Wetter 0.1%
Growing Season Rainfall	116mm

RESULTS

The soil, in particular the subsoil, is strongly acidic with a subsoil pH less than 4.0 between 10-50cm (Figure 1).

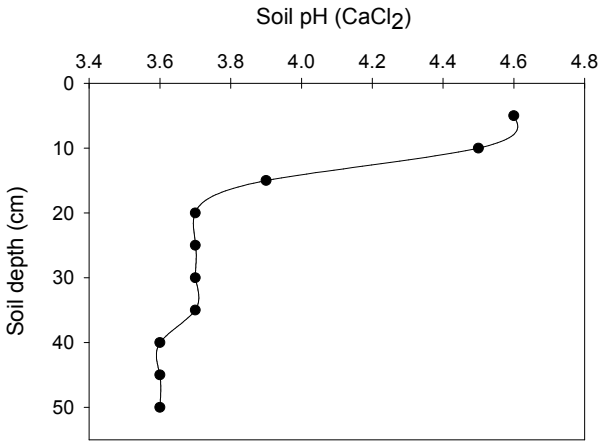

Figure 1: Soil pH of the untreated soil sampled 7/11/07.

Crop responses on the limed seams were clearly visible with distinct lines of improved crop growth. Harvest index cuts were taken to assess growth and yield improvements and yield components (Table 1). Deep placed lime to 31cm had 20% higher grain yield and deep placed lime to 51cm (in two passes) had 40% higher grain yield compared with their corresponding deep ripped but not limed treatments (Table 1). This improved yield was a result of increases in the number and weight of grain in each head. The number of heads was not affected.

Deep placed lime to 51cm increased machine harvest grain yield by 44% (180 kg/ha) compared with the ripped to 51cm only treatment (Table 2). Deep placement of lime to 31cm and deep ripping of surface applied lime gave no additional yield benefit over lime applied to the surface without deep ripping. There was no residual benefit from deep ripping compared with the unripped control.

Table 1: Shoot and grain yield and yield components taken from hand cuts.

Treatment	Shoot weight (kg/ha)	Grain weight (kg/ha)	Harvest Index	1000 grain weight (g)	No. of heads/ m^2	No. of grains/ m^2	No. of grains/ head	Weight of grain/ head
Control (no deep ripping, no lime)	1160	512	0.44	31.3	121	1633	13.7	0.43
Lime applied to the surface at 2.5 t/ha	1262	559	0.44	31.1	126	1794	14.3	0.44
Lime applied to the surface at 2.5 t/ha then deep ripped to 310mm	1301	571	0.44	31.3	124	1836	14.8	0.46
Deep ripping to 310mm	1133	510	0.45	30.9	119	1653	14.0	0.43
Deep ripping to 310mm + deep placed lime at 2.5 t/ha	1304	610	0.47	32.7	122	1871	15.5	0.51
Deep ripping to 510mm in two passes	1128	493	0.44	30.2	110	1622	15.1	0.46
Deep ripping to 510mm in two passes + deep placed lime at 2.5 t/ha each pass (5 t/ha total)	1531	687	0.45	33.4	119	2052	17.3	0.58
LSD (0.05)	175	86	n.s.	1.9	n.s.	225	2.1	0.07

ECONOMIC ANALYSIS

The deep placed lime treatments were the only treatments to substantially increase yield and gross margin with benefits of $25 for the deep placed lime to 31cm and $61/ha when the profile was limed to 51 cm (Table 2). The treatment costs for this trial were incurred in 2005 so they haven't been included in the 2007 season gross margin calculations. We estimate that the costs for deep banding 2.5 t/ha of lime to 30 cm is $150-200/ha and the cost of deep banding 5 t/ha of lime to 50cm to be of the order of $300-350/ha. These estimates are contract rates for deep ripping and a lime cost of $27.50/t delivered and include estimates of fuel, maintenance and labour costs determined from Bankwest benchmarks.

Table 2: Grain yield and grain quality of wheat from machine harvest and gross margin.

Treatment	Yield (t/ha)	Protein (%)	Screenings (%)	Grade	Gross Return	Variable Costs	Gross Margin
Control (no deep ripping, no lime)	0.42	14.0	2.9	ASW	152	70	83
Lime applied to the surface at 2.5 t/ha	0.44	14.4	3.0	ASW	159	70	90
Lime applied to the surface at 2.5 t/ha then deep ripped to 310mm	0.44	14.1	2.6	ASW	159	70	90
Deep ripping to 310mm	0.39	14.0	3.2	ASW	141	70	72
Deep ripping to 310mm + deep placed lime at 2.5 t/ha	0.49	13.5	1.9	ASW	177	70	108
Deep ripping to 510mm in two passes	0.41	13.6	3.1	ASW	148	70	79
Deep ripping to 510mm in two passes + deep placed lime at 2.5 t/ha each pass (5 t/ha total)	0.59	13.1	2.1	ASW	214	70	144
LSD (0.05)	0.05	0.3	0.8				

Based on EPR for 10/01/08 ASW Base Price $414/tonne.

COMMENTS

Deep placed lime can improve yields on acidic soils in a very dry season but significant yield increases were only achieved when lime was placed directly into the subsoil to depths of 31 or 51cm. Higher grain number per head indicates that the yield benefit was derived from better water and nitrogen availability early when grain number was being set but not early enough to improve the number of heads. Grain yield was strongly correlated with total shoot yield with both increasing with the deep lime-placement treatments resulting in no change in the harvest index. Larger yield improvements may have been achieved had narrower tyne spacings been used when incorporating the lime given that distinct lines of improved crop growth and yield were observed at the 45cm tyne spacing. Deep placed lime improved yields of wheat by 18% for both liming depths in 2005, the year the trial was established, and by 44% in 2007 for the lime placed to 51cm. Deep placed lime in a trial at Bodallin has increased the yield of 4 cereal crops grown over 6 seasons. Cereal yields in the Bodallin trial were increased by 16% in the first year and by 30% or more in subsequent cereal crops. Despite the high estimated cost of establishing the deep-placed lime treatments they are likely to be profitable over the medium term as it is anticipated that additional cereal crop yield increases will be seen in future seasons. Crop yield responses from deep placed lime have been recorded in either the year of application or 1-2 years after application. Generally, responses to surface applied lime take several years to develop as the surface applied lime takes a number of years to treat subsurface acidity.

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