Wodjil Workout - Determining economic rates and incorporation methods for lime in the Eastern Wheatbelt of WA; NW Koorda

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Key messages

- Lime rates did not affect triticale yield on Wodjil soil in a low yielding season at lower rates of lime, but at10 t/ha significantly reduced yields were present. This needs further investigation to determine the cause, as there was a trend for increasing lime rate to reduce yield above 5t/ha
- Lime incorporation method did not affect yield in a low yielding season.
- The most economic option in this season was to apply no lime. Liming is a long-term investment so responses are generally not expected in the first year.

Aims

Main aims of the project are:

- To demonstrate different methods of lime incorporation
- To assess the economics of incorporation
- To assess rate responses to lime through subsoil amelioration.

Method

Trial design was based around farmer sized machinery, using nearest neighbour controls to help gain some statistical significance.

Trial Details

The Wodjil soil type on the site is typical of the area with soil pH around 4.1 $CaCl_2$ (0-10cm), 3.8 (10-20cm) and 3.6 (20-30cm). Aluminium concentrations are between 30 and 60ppm, and 20-60% of the cation exchange capacity of the soil.

The site was low in phosphate (11-15mg/kg), marginal in potassium (50mg/kg in topsoil, 30mg/kg in midsoil) and low in manganese (0.4-3mg/kg)

There were 6 lime treatments: 0, 1, 2.5, 5, 7.5 and 10t/ha. (Optima Lancelin), applied at right angles to the tillage treatment.

There were 6 tillage treatments: Full cut scarifier, chisel plough, mouldboard, spader, twin disk and one way plough, while the control treatment also provided light incorporation of lime in the surface layer.

- 13th of April trial was spread with lime sand by a Marshall multi spreader, using a variable rate prescription.
- Knockdown 5th of June
- Trial was ripped to 30cm on the 11th of June with an Ausplow deep ripper, except the Mouldboard treatment.
- 12-23rd of June incorporation of treatments was conducted
- 24th of June sow trial to Speedy Triticale (70kg/ha), with 68kg/ha K-till Extra and 2kg/ha Manganese Sulphate. Trial was sown with an old Alfarm bar with floating seed boots and Agmaster star harrows.
- 4th of August broadleaf herbicide applied (750ml/ha Jaguar and 400ml/ha MCPA LVE 570)
- 5th of August 30l/ha UAN applied.
- 10th of December trial harvested by Kalyx small plot harvester.
- 185mm of rain fell during the growing season, of which 90mm fell after sowing.

Results

Due to the logistics of getting incorporation treatments conducted during a busy time of the year, the trial was always going to be sown late. However, a sowing time of the 24th of June with a short season Triticale such as Speedy would not have be considered too late in an average season.

Establishment

Establishment was good across all treatments due to shallow sowing, no pre-emergent herbicides and 5 mm of rain falling 9 days after sowing. This gave an average plant density of 148 plants/m2.

NDVI measurements were not taken due to the poor season and lack of canopy.

Yield

Due to only 90mm falling post sowing with minimal stored soil moisture, the yield results were not going to be high. The heat shock events experienced in late August, September and October reduced crop yield potential significantly.

The average yield for the site was 476kg/ha. While triticale is considered highly tolerant of aluminium the levels in this soil are exceptionally high and would have been affecting triticale root growth even with lime.

Yield variation throughout the site is evident, as seen in Table 1 below.

Table 1: Treatment cost pre harvest and Yield in t/ha.

Costs of Lime, Incorperation, Fertiliser and Chemical with Yield t/ha → N

Lime t/ha	Control	Full Cut $8	Chisel Plough $8	Control	Spader $180	Mouldboard $150	Control	Twin Disk $14	One Way Disk $6	Control
0	$168.60 0.315	$176.60 0.450	$176.60 0.375	$168.60 0.420	$348.60 0.330	$288.60 0.405	$168.60 0.390	$182.60 0.541	$174.60 0.511	$168.60 0.435
1	$208.60 0.292	$216.60 0.431	$216.60 0.368	$208.60 0.419	$388.60 0.330	$328.60 0.368	$208.60 0.406	$222.60 0.457	$214.60 0.393	$208.60 0.457
2.5	$248.60 0.344	$276.60 0.433	$276.60 0.344	$248.60 0.408	$448.60 0.370	$388.60 0.471	$248.60 0.433	$282.60 0.535	$274.60 0.497	$248.60 0.599
0	$168.60 0.317	$176.60 0.463	$176.60 0.426	$168.60 0.487	$348.60 0.439	$288.60 0.524	$168.60 0.305	$182.60 0.573	$174.60 0.670	$168.60 0.658
0	$168.60 0.420	$176.60 0.535	$176.60 0.446	$168.60 0.522	$348.60 0.548	$288.60 0.497	$168.60 0.446	$182.60 0.701	$174.60 0.522	$168.60 0.586
5	$368.60 0.489	$376.60 0.608	$376.60 0.622	$368.60 0.714	$548.60 0.661	$488.60 0.529	$368.60 0.608	$382.60 0.688	$374.60 0.595	$368.60 0.608
0	$168.60 0.459	$176.60 0.642	$176.60 0.655	$168.60 0.629	$348.60 0.577	$288.60 0.445	$168.60 0.577	$182.60 0.577	$174.60 0.537	$168.60 0.590
7.5	$468.60 0.463	$476.60 0.643	$476.60 0.643	$468.60 0.579	$648.60 0.566	$588.60 0.463	$468.60 0.553	$482.60 0.566	$474.60 0.527	$468.60 0.502
10	$568.60 0.282	$576.60 0.452	$576.60 0.424	$568.60 0.358	$748.60 0.292	$688.60 0.132	$568.60 0.311	$582.60 0.358	$574.60 0.245	$568.60 0.348
0	$168.60 0.376	$176.60 0.623	$176.60 0.597	$168.60 0.584	$348.60 0.389	$288.60 0.299	$168.60 0.363	$182.60 0.428	$174.60 0.376	$168.60 0.454

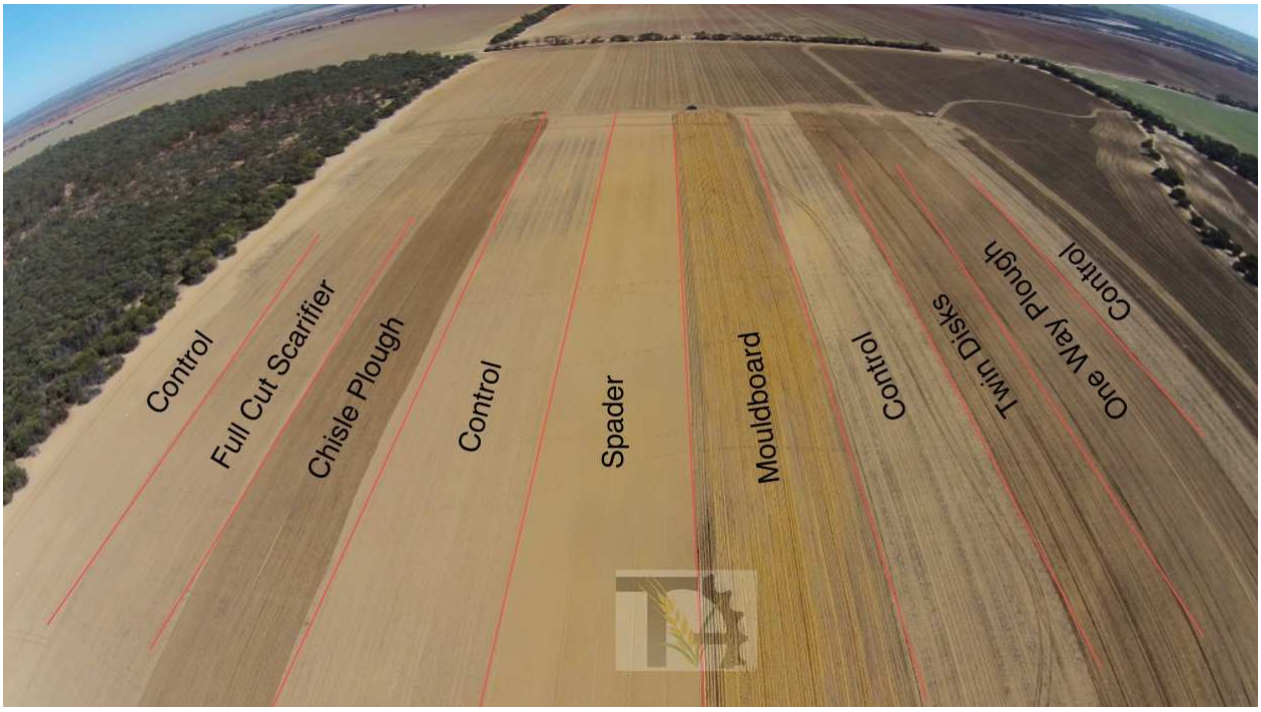

Figure 3: Aerial shot post incorporation, pre sowing.

Statistical Significance

A linear mixed model with an autoregressive error structure was fitted to the yield data, revealing a significant effect of lime but not of the machinery treatments, and no interactions. The lime effect was due to reduced yield at 10t/ha; none of the other lime rates were significantly different from 0t/ha. While some of this negative effect can be attributed to a blowhole that coincides with the 10t/ha of lime and mouldboard treatment, the consistent reduction in yield in all other tillage treatments from 7.5t/ha to 10t/ha with some recovery of yield on the adjacent control plot suggests that the additional 2.5t/ha of lime is possibly having at least some deleterious effect on yield.

Conclusion

After receiving only 190mm of rainfall for the growing season and 90mm after sowing along with the heat shock events experienced in late August and September, it is hard to expect responses to lime sand and tillage when the average treatment yield was 460kg/ha.

Site variation has not allowed any treatment effects, if present, to be clearly identified. Triticale has useful levels of aluminium tolerance so this may have mitigated against the effects of the liming treatments.

Machinery Incorporation

Responses to incorporation treatments looked to be somewhat negative due to drying of the soil profile from tillage prior to seeding. The untreated – deep ripped treatments looked better throughout the year due to greater moisture reserves and not being dried out by a tillage pass.

Lime Rates

Looking at the different lime treatments, there is an increase in yield up to 5t/ha, then yield decreases. It is most likely that the decrease in yield in the higher treatments is largely due to site variation. However there is some statistics backing up the negative effect of 10t/ha of lime vs control. It is not clear what caused this yield reduction. There were no visual differences in the canopy during the growing season.

The subsoil for the site has a pH range 3.4 – 4.1 in $CaCl_2$, therefore one would expect the higher lime rates to perform better over time, especially in combination with good subsoil incorporation, but we will need substantial rainfall to facilitate this reaction.

Economics

Due to the poor season, the higher the cost attributed from either lime or machinery resulted in a bigger net loss per hectare. Hopefully over time we will see this change around as subsoil amelioration occurs. Now established, the demonstration area can be monitored in coming years for a relatively small investment.

Further Material

Click on the links to view You Tube clips and pictures taken on spreading the trial and some of the incorporation treatments.

Wodjil Workout photo's

Tek Ag YouTube

Tyrone Henning Photobucket site

– Wodgil Workout Photo's

Youtube site

– Tek Ag You Tube

Key words

Wodjil, Lime, Subsoil, Incorporation.

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