Large benefits to wheat performance from adding clay to a sandy soil at Brimpton Lake

RESEARCH

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Location
Brimpton Lake - Greg & Luke Moroney
Group: LEADA
Rainfall
Av. Annual: 464 mm
Av. GSR: 350 mm (May-Oct)
2018 Total: 374 mm
2018 GSR: 297 mm
Yield
Potential: 6.0 t/ha (W)
Actual: 2.4 t/ha (District average for this soil type)
Paddock History
2017: Lupin
2016: Barley
2015: Wheat
Soil Type
Shallow sand over clay: 0-10 cms light grey, moderately water repellent sand; 10-30 cms bleached white sand; 30-50 cms yellow sodic clay; > 50 cms orange clay with carbonate increasing at depth.
Plot Size
25 m x 2.6 m 4 reps
Trial Design
Experimental: Randomised block
Yield Limiting Factors
Decile 2/3 GSR in 2018, water repellence

Key messages

- **Residual responses to treatments applied in 2014 are still apparent in 2018 with more than double the grain yield on the best treatments compared to the control.**
- **Water repellence resulted in staggered emergence and significantly lower plant numbers on the unclayed treatments. Addition of clay overcame this, resulting in higher plant numbers even with clay mixed into the topsoil only.**
- **Spading increased wheat yields in 2018 by more than 75% over the control, but with no additional benefit from the 2014 addition of clay or high rates of mineral nutrients or lucerne hay.**
- **Spading with lucerne hay in 2014 has provided the greatest cumulative yield across the life of the trial.**

Why do the trial?

Sandy soils on lower Eyre Peninsula (EP) commonly deliver less than half the yield of crops on other soil types. Constraints to production on these soils include water repellence, compaction, low fertility and water holding capacity and low soil organic carbon levels. With support from the EP Farmer Rail Levy, LEADA and PIRSA, a trial site was established in 2014 at Brimpton Lake. The trial aimed to:

- Identify if clay addition increased production,
- Determine if clay mixing using a spader provided better responses than shallow clay incorporation,
- Identify if the addition of nutrients either as fertiliser or as organic matter with or without clay increased yield.

This is one of three trial sites (the others at Karoonda and Cadgee) developed in the New Horizons program and builds on previous research conducted on sands at Ungarra, Edillilie, Wanilla and elsewhere. Soil and production data has been collected annually with the site incorporated into the GRDC-funded Sandy soils project in 2017. Results from these trials have informed development of a site established at Murlong in April 2018.

How was it done?

The site was established in 2014 on a low sandy rise. The trial comprises 12 treatments x 4 replicates consisting of an unmodified control (managed as district practice) and spading with and without a nutrient package and/or organic material, with or without clay (Table 1).

Treatments, applied in 2014 only, were: unmodified control; deep nutrition-banded @ 15-20 cm; shallow clay; shallow clay + nutrient; spading; spading + nutrient; spading + clay; spading + clay + nutrient; spading + lucerne; spading + lucerne + nutrient; spading + clay + lucerne; spading + clay + lucerne + nutrients. Seven key treatments are reported here.

Measurements taken include pre-seeding soil water and mineral nitrogen, crop establishment, biomass at flowering, “tea bag” index, grain yield, yield components, grain quality, post-harvest soil water and crop lower limits.

Table 1 Trial establishment in 2014 and 2018 cropping details

April 2014	Treatments applied	• Clay (40-50 % clay content) applied at an average of 450 t/ha • Spading to 30 cm • OM as lucerne hay @ 10 t/ha • Nutrient package (kg/ha): N 60, P 30, K 50, S 10, Zn 4, Mn 6, Cu 3
10 May 2018	Pre-seeding herbicide	2 L/ha Weedmaster + 2 L/ha TriflurX + 118 g/ha Sakura
	Seeding	Grenade CL wheat @ 80 kg/ha, DAP Zn2 @ 75 kg/ha, SOA @ 126 kg/ha.
4 December 2018	Harvest	

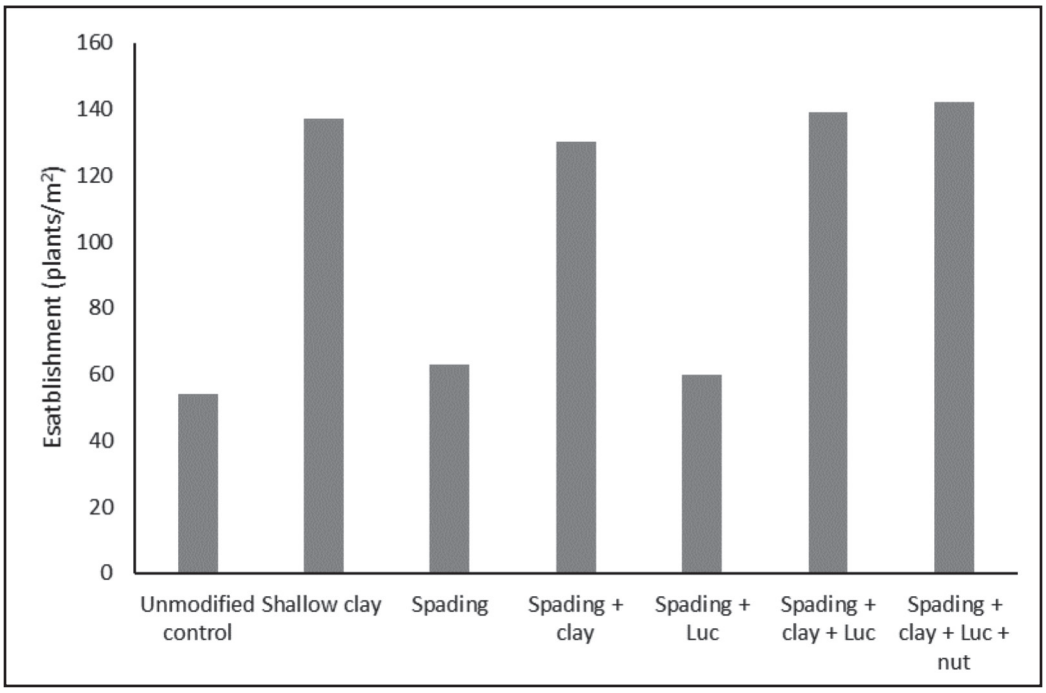

Figure 1 Establishment (plants/m²) of wheat at Brimpton Lake in July 2018, showing the positive impact of clay addition to overcome water repellence and increased establishment (LSD 5%=37)

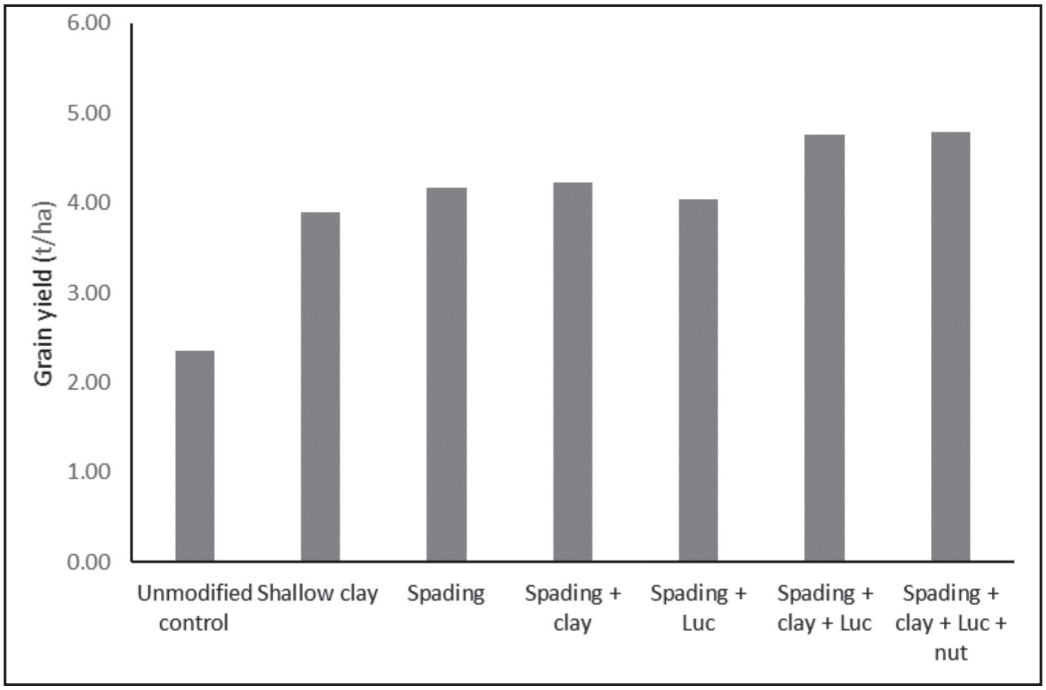

Figure 2 Grain yield (t/ha) at Brimpton Lake in 2018 (LSD 5%=1.05 t/ha)

Table 2 Annual grain yield (t/ha) for the life of the project (figures in bold are significantly different to the control)

Year	2014	2015	2016	2017	2018	Total yield increase (t/ha)	Yield increase (%)
Crop	wheat	wheat	barley	lupin	wheat		
unmodified (control)	1.40	1.89	3.63	1.07	2.35	10.34	-
deep nutrition	**1.86**	2.18	3.44	1.38	2.85	1.37	13
shallow clay	**2.01**	**2.75**	3.74	1.36	**3.89**	3.41	33
shallow clay + deep nutrition	1.51	2.05	3.71	1.11	3.36	1.40	14
spading	**2.29**	**2.71**	3.67	**1.58**	**4.17**	4.08	39
spading + nutrition	1.56	**2.68**	3.22	**1.97**	**4.52**	3.61	35
spading + clay	**2.48**	**2.85**	3.97	**1.59**	**4.22**	4.77	46
spading + clay + nutrition	**1.69**	**2.48**	3.90	**1.60**	**4.30**	3.63	35
spading + luc	**2.96**	**3.69**	3.94	1.50	**4.04**	5.79	56
spading + luc + nutrition	**2.85**	**3.82**	3.91	**1.66**	**4.58**	6.48	63
spading + clay + luc	**2.62**	**3.42**	3.63	**1.59**	**4.76**	5.68	55
spading + clay + luc + nutrition	**2.81**	**3.38**	4.01	**1.69**	**4.79**	6.34	61

What happened?

A dry start to the season resulted in staggered emergence and lower plant numbers on unclayed treatments (Figure 1).

- Early-mid season vigour was greater on all the clayed treatments (data not shown).
- Although flowering was delayed by 2-3 weeks on the late germinating treatments a cool finish to the season allowed these treatments to fill.
- While physical disturbance from spading appeared to be the major driver of increased grain production (>70%), the surface clay treatment also delivered significantly higher yield compared to the control (Figure 2).
- Some treatments which had poor establishment still produced high grain yields. The spading and spading + lucerne treatments, with lower established plants, still yielded as high as the spading + clay treatment (Figures 1 and 2).

What does this mean?

The 2018 results confirm that treatments addressing major constraints on sands can deliver lasting yield increases. However, the severity of constraints and the subsequent impact on yields will vary depending on seasonal factors and crop type. Analysis of results over the 5 years of the trial show that:

- Physical intervention has provided ongoing yield benefits with spading alone delivering a 4.1 t/ha increase in yield over the 5 years of the trial (Table 2).
- Despite overcoming water repellence and improving plant numbers, clay application has only added an additional 3.4 t/ha.
- The addition of organic matter delivered yield increases in the first 2-3 years following application, but the impact appears to have declined. Overall, the best performing treatment (spading + lucerne + nutrients) delivered a 6.5 t/ha yield increase over the life of the trial.

While this work has delivered large yield increases, these interventions can be costly and further research is required to determine if other cheaper forms of physical intervention (mouldboard ploughing, ripping with inclusion plates, etc.) can provide similar impact and longevity to spading. Also, there is a need to understand the causal relationships to determine if lower rates of organic amendments can provide similar outcomes.

Acknowledgements

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