Improved productivity on sandy soils - Kybunga case study 2021

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Key Findings

- Deep ripping and/or spading treatments increased lentil yield in 2021 by 0.25 – 0.4 t/ha (37 – 59%).
- Over three seasons, deep ripping to 50 cm increased the cumulative partial gross margin (PGM) by $553/ha, generating a 426% return on investment.
- Treatments including spading and/or chicken litter produced high cumulative grain yield and cumulative PGM was equivalent to deep ripping to 50 cm but had lower return on investment due to their higher cost basis.
- All treatments have reduced penetrometer resistance, with the treatment effects detectable over two years after implementation. Treatments including deep ripping have had a greater impact to greater depth than the shallow rip or spading treatment.

How was it done?

Trial location:	Kybunga (Blyth BOM annual rainfall 365 mm, growing season 247 mm)
Plot size:	1.5m x 20.0m
Seeding date:	May 28, 2021
Variety:	PBA Highland XT
Fertiliser:	MAP @ 80 kg/ha
Previous crops:	2020 Spartacus barley 2019 Scepter wheat
Soil constraints:	Low organic carbon, low cation exchange capacity**,** mild water repellence and compaction

The trial was a randomised complete block design with seven treatments and four replicates. Chicken litter (CL) was applied to the surface of plots where applicable prior to the implementation of soil disturbance treatments.

All soil disturbance treatments were implemented on May 13, 2019. Ripping treatments were conducted using a Williamson-Agri Ripper, a bent leg low disturbance ripping machine with four tynes per plot. Ripping depth was either shallow (30 cm) or deep (50 cm). Spading was conducted with a 1.8 m Farmax spading machine operated at 5 km/h to a depth of 30 cm.

Treatments

1. District practice (control)
2. Shallow ripping (30 cm)
3. Deep ripping (50 cm)
4. Spading (30 cm)
5. Deep ripping + spading
6. Deep ripping + chicken litter @ 7.5 t/ha
7. Spading + chicken litter @7.5 t/ha

GreenSeeker NDVI data and grain yield was collected each season to measure crop performance. Crop measurements during the growing season included emergence, vigour and herbicide damage scores (data not presented), GreenSeeker NDVI on July 29 and grain yield. For specific details of dates in prior seasons see the previous trial reports.

Results and Discussion

Lentil performance in 2021

GreenSeeker NDVI was recorded early in the growing season with values only averaging 0.252. Bare earth NDVI values are generally about 0.16. There is little consistency with treatment or aggressiveness from this assessment.

Grain yield results for 2021 show that the untreated control produced the lowest grain yield in the trial (0.68 t/ha). Yield responses to ripping show a trend of increasing yield with increasing ripping depth, though Rip 30 was not significantly different to the untreated control (Table 1). Ripping to 50 cm and the more aggressive mixing treatment of spading increased lentil grain yields to an average of 0.99 t/ha. The addition of chicken litter did not provide any yield improvement in 2021, which is the third crop season since application.

Table 1. GreenSeeker NDVI recorded July 29 and grain yield (t/ha) for PBA Hurricane XT lentil at Kybunga 2021.

Treatment	GreenSeeker NDVI July 29		Grain yield (t/ha)	
Control	0.246	bc	0.68	c
Rip 30	0.257	ab	0.81	bc
Rip 50	0.242	c	0.95	ab
Spade 30	0.265	a	1.08	a
Rip50 + Spade	0.241	c	0.93	ab
Rip50 + Chick	0.260	a	0.97	ab
Spade + Chick	0.253	abc	0.99	ab
LSD (P≤0.05)	**0.014**		**0.23**	

Partial gross margin (PGM)

Despite significant costs of up to $460/ha associated with some of these treatments, all treatments had covered costs and generated a positive return on investment after the first season in 2019. Positive benefits have continued to accumulate in the following two seasons (Figure 1). The Rip 30 treatment has generated an additional $347/ha cumulative partial gross margin (PGM), whereas Rip50 has increased cumulative PGM by $553/ha over the untreated control.

Treatments including spading or chicken litter tended to have higher cumulative grain yields than the straight Rip50 treatment. However, cumulative PGM was not significantly higher due to the higher costs for these treatments. Due to the high cumulative PGM for Rip 50 and the lower (relative) cost basis this treatment had the highest return on investment of 426%.

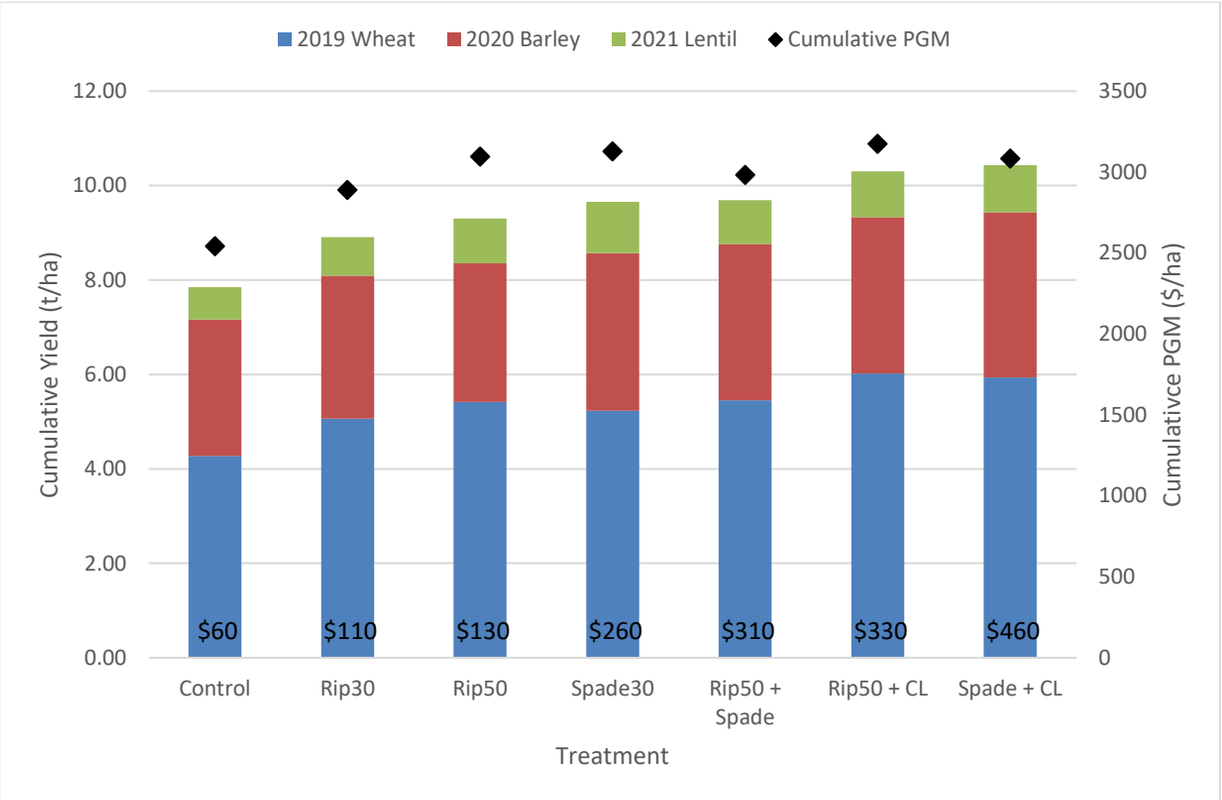

Figure 1. Cumulative grain yield and partial gross margin analysis for seasons 2019, 2020 and 2021 for the Kybunga low OM trial. Price assumptions include chicken litter $34.5/t, SoA $400/t, wheat ASW (2019) $310/t, wheat H2 (2019) $320/t, barley BAR1 (2020) $220/t, lentil NIP1 (2021) $1000/t. Estimated treatment costs are shown on each bar. Cost of spading in the deep rip plus spading treatment is reduced due to pre-ripping. Non-CL treatments received additional SoA ($60/ha) in 2019.

Penetrometer Resistance

Measurements of penetrometer resistance were made at this site in the winter of 2021 (Figure 2), which is greater than two years after treatments were implemented. Results show that compaction is likely to be a significant constraint, where penetrometer resistance exceeds 2500 kPa from 150 to 375 mm depth.

Treatment depth of intervention is clear, where the shallow rip and spade treatments that both target a depth of 30 cm only influence to this depth and do not address deeper compaction. The deep rip treatment targeting 50 cm depth has reduced penetrometer resistance deeper into the profile, such that no depth in the soil profile exceeds resistance of the 2500 kPa threshold.

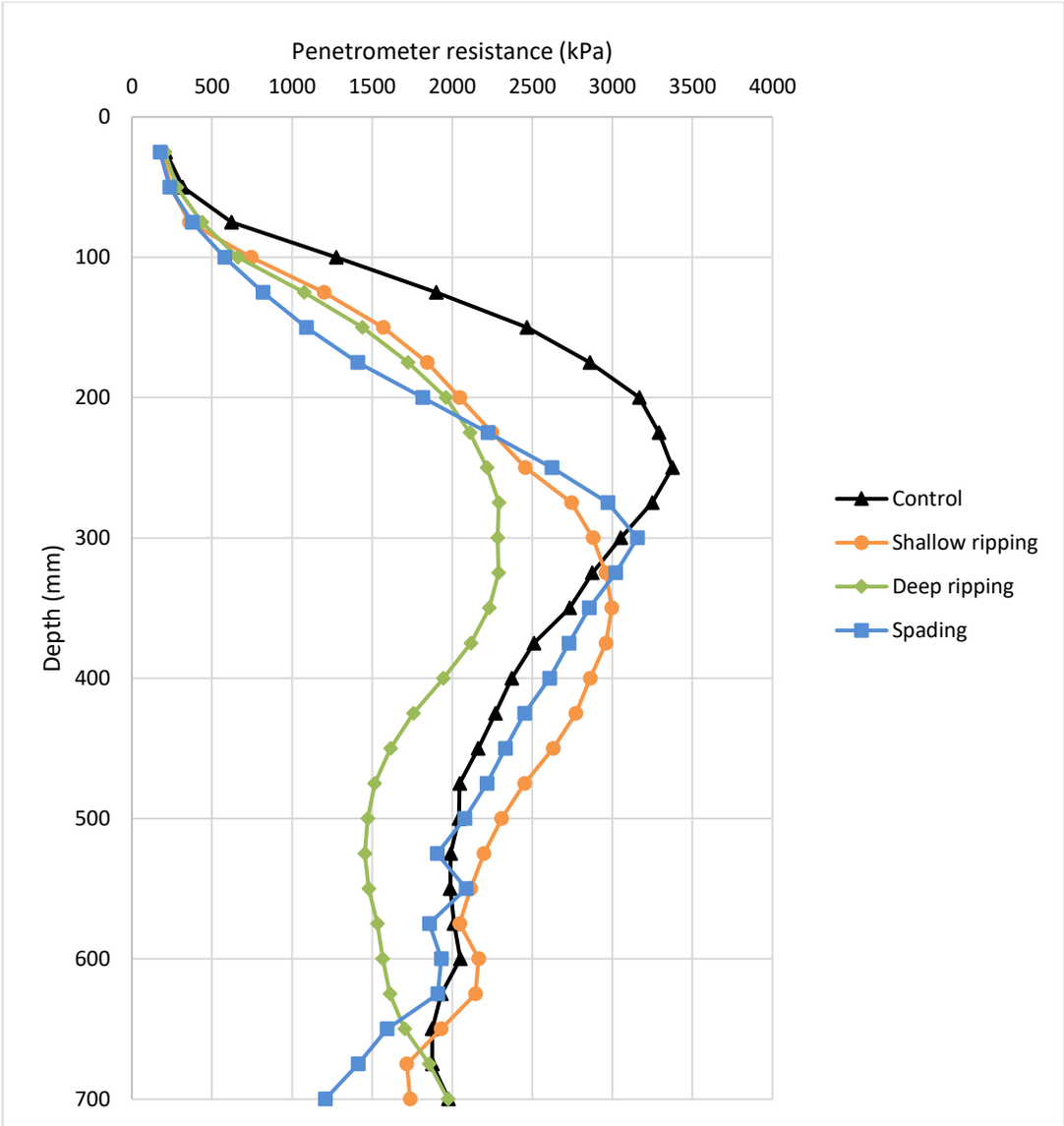

Figure 2. Penetrometer resistance measured using a cone penetrometer for selected treatments in winter 2021.

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