Demonstrating the Benefits of Soil Amelioration ("Ripper Gauge")

Juniper Kiss, Liebe Group, and Dylan Hirsch, Hirsch Farms

Key Messages

- Deep ripping can provide a significant yield benefit which can last for several years.
- Deep ripping does not always provide statistical or economic yield benefit immediately.
- Subsoil nutrient recovery and redistribution following deep ripping can be significant and should be considered when planning fertiliser applications.
- Controlled traffic can prolong the effect of deep ripping on subsoil strength (compaction).

Aim

To evaluate and demonstrate the benefit of soil amelioration and controlled traffic farming. To evaluate differences in deep ripping timing over subsequent years.

Background

Previous GRDC research trials have found that shallow ripping (30-40 cm), deeper ripping (>50 cm), and deep ripping with topsoil slotting increased wheat yields by 8%, 35%, and 53% (Davies et al., 2017).

This trial was established in 2021, when the paddock was in a canola phase. Ripping was conducted at 1 week, 3 weeks and 6 weeks after sowing, with an unripped strip kept as a control. The Hirsch's have always seen canola and deep ripping as a package, because of canolas' ability to use subsoil moisture and produce a reliable yield response, and the tillage effect of stimulating weeds where they can be controlled with glyphosate or selective herbicides. However, it can be risky, with plant establishment sometimes reduced by inconsistent depth control in softer sands when seeding after ripping. Reduced plant establishment can undo the yield response of canola in this system.

Deep ripping post seeding, when there is adequate subsoil moisture available is considered an option to alleviate potential reduction in plant establishment however this comes with significant logistical issues (e.g., machinery and labor availability, risk of seedling mortality). After seeing the effects of Early Post Emergent deep ripping trial strips on previous canola crops, Dylan implemented this trial to better assess the effects of different timings of post-emergent deep ripping. The soil was previously deep ripped in 2017 and is a yellow sandy loam, which is considered easy to rip when there is moisture in the soil.

In 2022, the site was sown to wheat to continue to measure the effects of the deep ripping.

Trial Details

Trial location	Hirsch Property, Latham
Plot size & replication	12.2m x 400m x 2 replications
Soil type	Sandy Loam
Paddock rotation	2018: Canola 2019: Wheat 2020: Wheat 2021: Canola 2022: Wheat
Sowing date	19/05/2022
Sowing rate	60 kg/ha Vixen Wheat
Fertiliser	85 kg/ha MacroPro, 40 L/ha UAN banded
Herbicides, Insecticides & Fungicides	2.5 L/ha Boxer Gold, 240 mL/ha Voraxor IBS 1 L/ha Jaguar, 300 mL/ha MCPA @ 3 leaf
Harvest date	08/12/2022

Treatments

T1	Unripped (Control)
T2	Ripped @ 2-3 leaf canola stage 20th May 2021. Moist but not saturated profile
T3	Ripped @4-6 leaf canola stage 31st May 2021. Dry topsoil with moist subsoil
T4	Ripping @ 8 leaf canola stage 16th June 2021. Moist but not saturated profile

Soil composition

Table 1. Soil nutrient analysis and moisture % taken on the 22nd of April, 2022 at Latham.

Treatment & Depth	NH3 (mg/kg)	N03 (mg/kg)	P Colwell (mg/kg)	K Colwell (mg/kg)	S (mg/kg)	Zn (mg/kg)	OC (%)	EC dS/m	pH (CaCl2)	Soil Moisture (%)
T1 0-10	2	3	28	106	11.8	0.28	0.71	0.069	6.2	0.9
T1 10-30	2	3	10	73	16.2	-	0.35	0.044	4.9	0.8
T2 0-10	2	10	31	127	8.3	0.45	0.56	0.063	6.3	0.9
T2 10-30	2	9	11	79	14.3	-	0.33	0.048	4.6	1.9
T3 0-10	2	8	33	130	10.3	0.21	0.65	0.067	6.2	0.7
T3 10-30	1	4	12	62	18.3	-	0.35	0.054	4.8	1.4
T4 0-10	2	8	35	129	14	0.19	0.5	0.062	6.1	1.1
T4 10-30	2	3	9	71	16.2	-	0.34	0.047	4.7	0.1

Results

2022 wheat plant establishment (figure 1) and NDVI (figure 2) did not vary between the treatments. The soil strength (compaction) statistically significantly differed between T1-T2, T1-T3, T1-T4, and T3-T4 (F_3=17.51, P<0.001) (Figure 2). Soil compaction below 50 cm was lower in the deep ripped plots. The soil was not water-repellent across the trial. The average yield varied between 3.15-3.95 t/ha (Figure 4) and T2 (ripping 1-week post-seeding) had the highest yield overall.

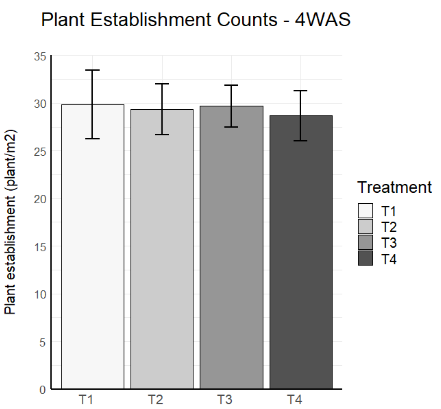


Figure 1. Wheat crop establishment at 4 weeks after sowing (4WAS) did not statistically differ between the different ripper treatments at the Ripper Gauge trial at Latham in 2022. Error bars are ± SEM.

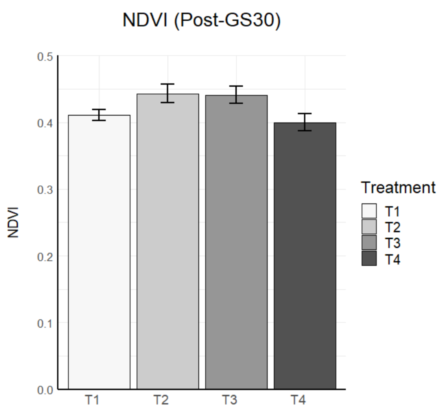


Figure 2. Whilst the NDVI appeared to be lower in the control plots, NDVI overall did not statistically differ between the treatments (P > 0.05). Error bars are ± SEM

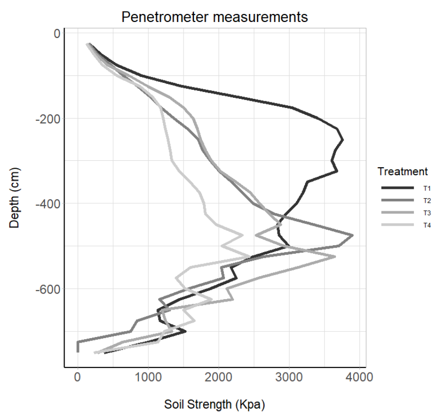
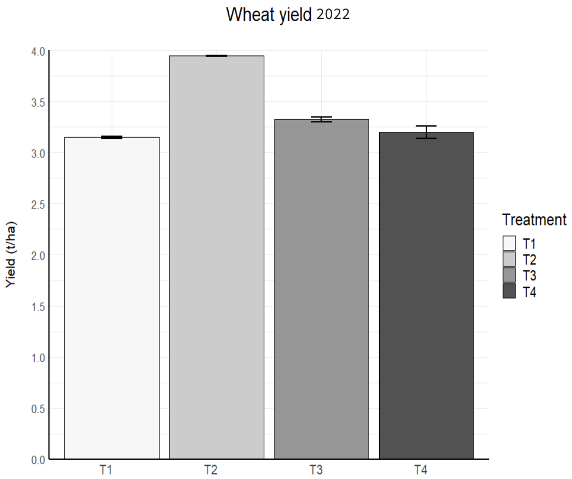


Figure 3. The soil strength (compaction) statistically significantly differed T1 (control) and all the other treatments in August 2022.



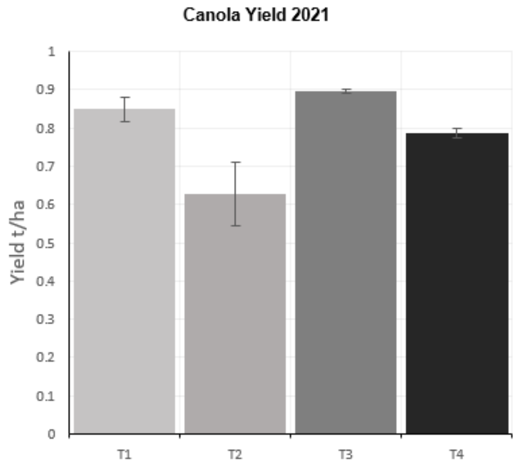


Figure 4. Yields of wheat in 2022 (left) and yield of canola in 2021 at Latham (right).

Comments

In 2022, there was an even establishment of wheat accoss the trial (figure 1). There did appear to be a lower amount of biomass indicated by NDVI readings in the control treatment (T1) (figure 2), however this was not statistically significant. Penetrometer readings taken in August 2022 (figure 3), highlighted the continuing effect of the deep ripping on soil compaction, with the control (T1) being significantly more compacted than all of the ripping treatments. This however did not translate into a significant yield benefit across all ripping treatments at harvest time (figure 4.) The data indicated a higher yield in treatment 2, which was the lowest yielding treatment in the 2021 canola crop. In 2021, treatment 2 was lower yielding due to higher plant mortality as a result of the ripping one week after sowing. This may have left a higher level of moisture and nutrition in the soil for the 2022 wheat crop to utilise. This is only marginally supported by the soil composition results, which show treatment 2 to have slightly higher levels of Nitrate N and Potassium in the top 30cm, as well as slightly higher subsoil moisture reading (table 1) than the other treatments. All ripped treatments had higher nitrogen N, phosphorous P and potassium K levels than the control, suggesting that the previous canola crop may have redistributed subsoil nutrients to the topsoil in ripped plots. There was also a slightly elevated amount of Zn in the top 10cm compared to the other treatments. It must be noted that these soil measurements are unreplicated and are providing a guide only.

Although the treatments have not produced a significant economic return on deep ripping, the trial will continue to be harvested in 2023 and 2024 to measure yield differences across treatments.

References

Davies S, Parker W, Blackwell P, Isbister B, Better G, Gazey C, and Scanlan C (2017). Soil amelioration in Western Australia. (Department of Agriculture and Food, Western Australia). Available at: https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2020/02/recommendations-for-deep-ripping-sandy-soils.

Peer review

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Contact

The Liebe Group
research@liebegroup.org.au
08 9661 1907