Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Deep ripping in forest gravel soils – West Kendenup

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KEY MESSAGES

- Deep ripping did not affect depth to free water in 2018 or 2019, however they were decile 2 and decile 1 growing seasons in terms of rainfall at Kendenup West.
- Yield data was limited; however deep ripping may have produced a cultivation effect that slightly increased yield.
- Deep ripping is unlikely to be a reliable management option for waterlogging in forest gravel soil.

Background to the activity

Ironstone gravelly soils or 'forest gravel' soils are common in the western areas of the Albany Port Zone's high rainfall region. A significant yield gap has been identified in the region, and a common constraint in seasons with above average rainfall is waterlogging. Local growers have seen mixed results from cultivation on forest gravel soils and are interested in investigating how deep ripping impacts drainage to potentially reduce and delay the onset of waterlogging in problematic areas.

This site was established in 2018 and effects were measured in the following canola crop, revealing no clear response to deep ripping in terms of waterlogging nor yield. Similar monitoring continued in 2019 under a wheat crop.

Activity objectives

The activity aimed to measure the effect of deep ripping on depth to free water (waterlogging) and the associated yield response of canola (2018) and wheat (2019) after deep ripping on this soil type.

Methods

The site was set up by a Kendenup West grower in a paddock with forest gravel soil. The western end of the paddock is prone to waterlogging, which led to several transverse drains being dug many years ago, though these are now filled in. In February 2018, trial strips approximately 450m long were deep ripped. Different combinations of tine spacing, inclusion plates and wings made six treatments separated by unripped sections (Fig. 1). There was no replication. Thus, all deep ripping treatments were grouped (Ripped) and compared to unripped treatments (Nil).

The site was sown to Scepter wheat on 7 May, 2019. A new monitoring transect was established following an old filled in drain, about 5m to from the eastern edge of the drain (Fig. 1). Twenty-four pipe dipwells were installed on 9 July, using an auger to install them at least 40cm deep. In pairs they were installed 3m from a treatment boundary marker which was in the middle. Depth to free water, or depth to the water table, was measured during the season from July to October by lowering a modified tape measure into the wells to hit the water surface. Rainfall data was downloaded from the Mount Barker weather station 5km south of the site.

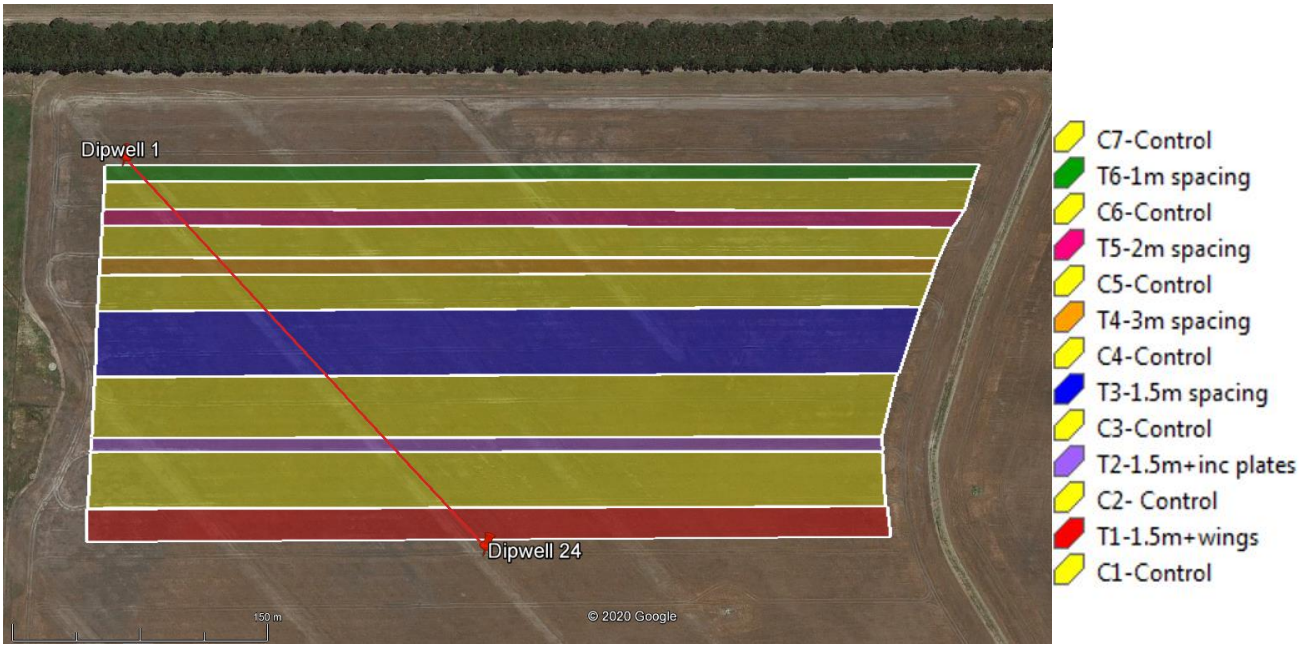

Figure 1. Trial layout showing treatment strips and the 2019 monitoring transect (red line) along an old drain with dipwells 1 to 24 located in pairs at treatment boundaries.

Results and discussion

Mount Barker recorded 426mm rainfall from April to October. When compared to Mount Barker's 20 year rainfall records, the trial area experienced a decile 2 growing season (Fig. 2). Similarly, 2018 was a decile 3 year for growing season rainfall at 433mm. Thus, neither year was optimal for studying waterlogging.

Depth to free water

The maximum depth of wells varied along the transect so all measurements of depth to free water exceeding 30cm were cut off at 30cm and noted as dry for visual representation in Figure 3.

A t-test was applied to raw data to compare depth to free water between Ripped and Nil treatments. There was no significant difference (α=0.05) in mean depth to free water

when averaged across the paddock and over all days measured ($t_{(214)}$=-0.90, p=0.37), with average depths of 31cm and 32cm respectively.

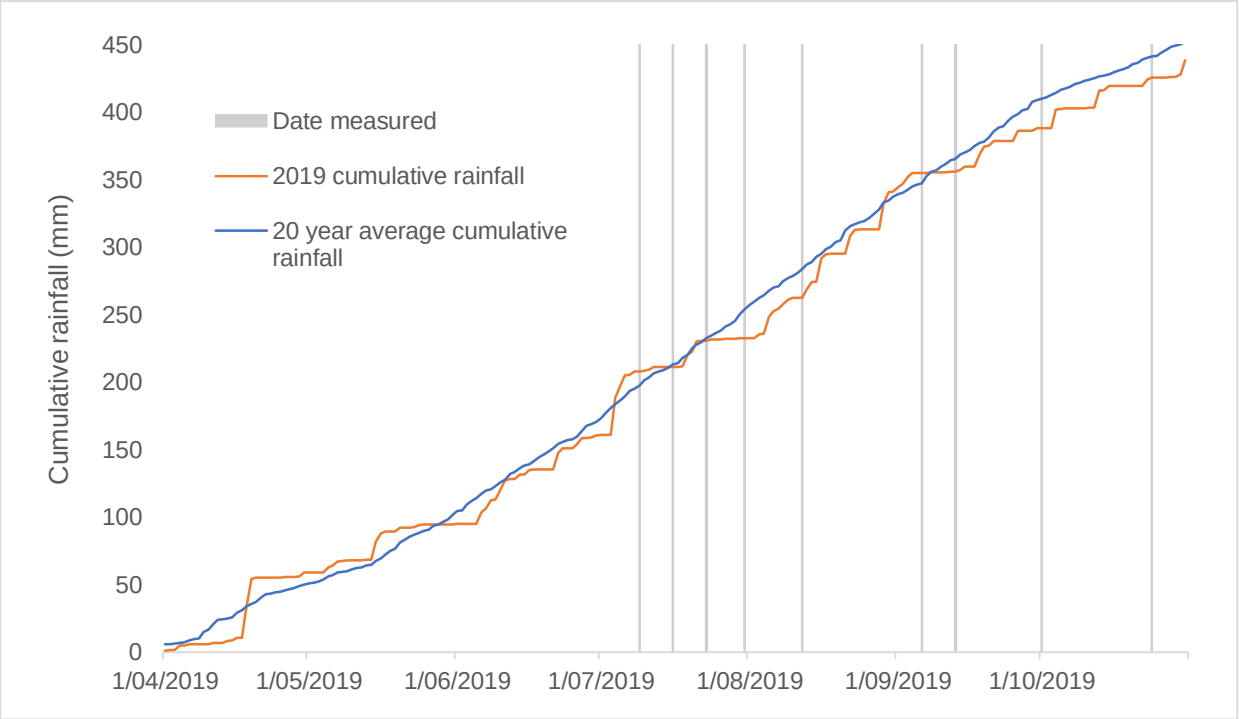

Figure 2. Cumulative growing season rainfall (April to October) in 2019 at Mount Barker, compared to average rainfall. Grey bars indicate dates that depth to free water was measured.

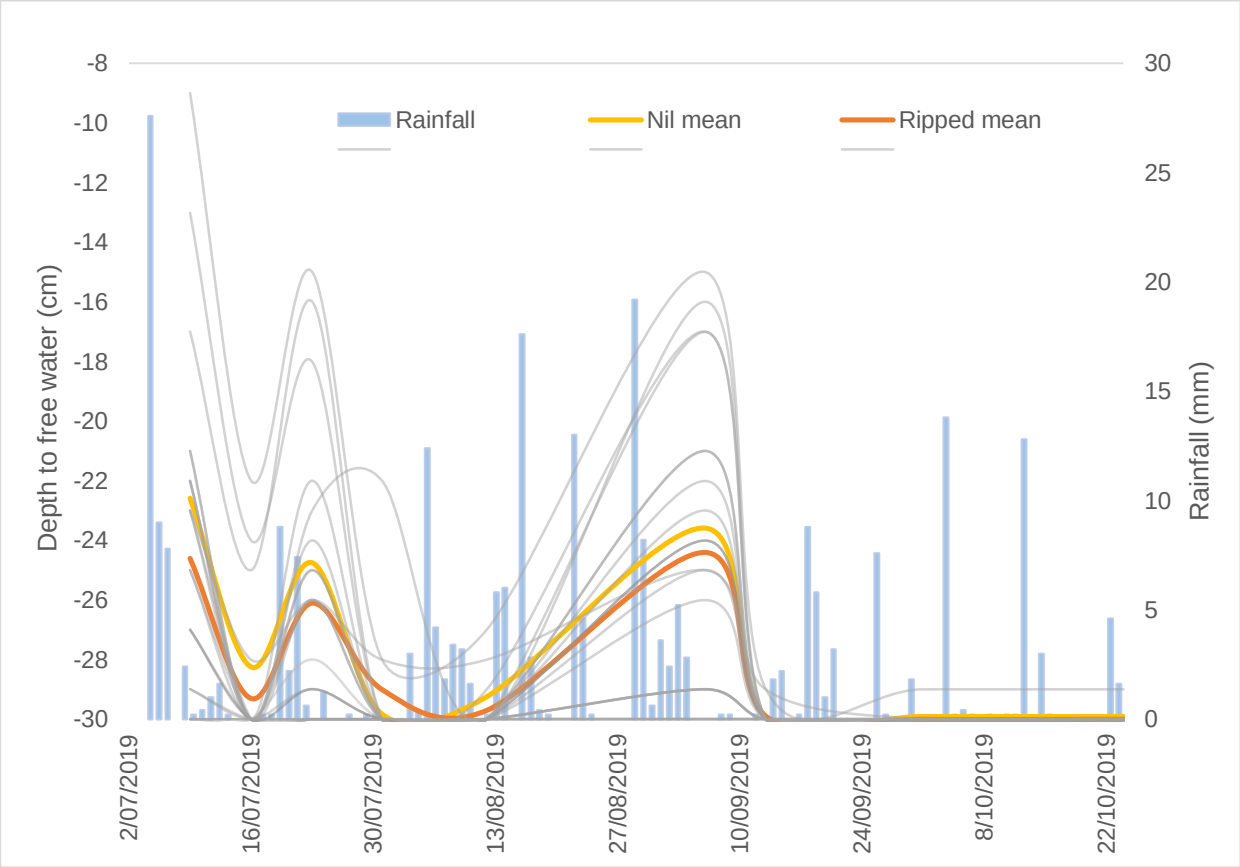

Figure 3. Depth to free water measured from July to October 2019 from dipwells installed on deep ripped (Ripped) and unripped (Nil) treatment strips in a wheat crop. Grey lines show raw data from 21 wells, coloured lines are treatment means. Daily rainfall (Kendenup West) is represented by columns.

Further analysis of data collected after rainfall events that caused peaks (Fig. 3) in depth to free water was conducted. A t-test was applied to data collected on 9 July, 23 July and 6 September. Still, there was no significant difference in depth to free water between Ripped and Nil treatments ($t_{(70)}$=-0.26, p=0.80). From those dates, the mean depth to free water for Ripped and Nil treatments was 24.8cm and 25.2cm respectively, which is insignificant both statistically and practically.

Figure 3 shows how daily rainfall interacted with mean depth to free water across Ripped and Nil treatments over the monitoring period. All wells are shown in light grey to illustrate variability across the transect and over time. Within the monitoring period the water table was shallowest after a 38mm rainfall event on July 4-5. The water table dropped and plateaued below 30cm from mid-September onwards (Fig.3). The deepest wells were recorded dry down to 45cm, though the water table may have been lower at times.

Yield analysis

Yield data is incomplete due to a second header not monitoring yield (Fig. 4). The paddock average yield recorded by the header was 6.58t/ha. The grower reported 5.5t/ha paddock average so data were adjusted accordingly. Average yield from whole strips were compared where the data points aligned to treatments, but the lack of replication and data points made statistical analysis unreliable. Average yield between treatments was also compared from a more uniform looking zone of the paddock, as outlined in white in Figure 4.

Mean yields from both comparisons (full strip and yield zone) are displayed in Figure 5. Due to the incomplete nature of the yield data, there are only 4 replicates for the Nil treatment and 3 replicates for the Ripped treatment. From these data, there was a slight increase in yield from deep ripping, however statistical significance cannot be not implied due to the lack of replication. It is possible that while deep ripping did not significantly affect drainage, there may be a continuing cultivation effect of redistributing nutrients and increasing nutrient mineralisation, contributing to yield gains. Satellite NDVI imagery (DataFarming) did not reveal any obvious effects in biomass accumulation in relation to deep ripping.

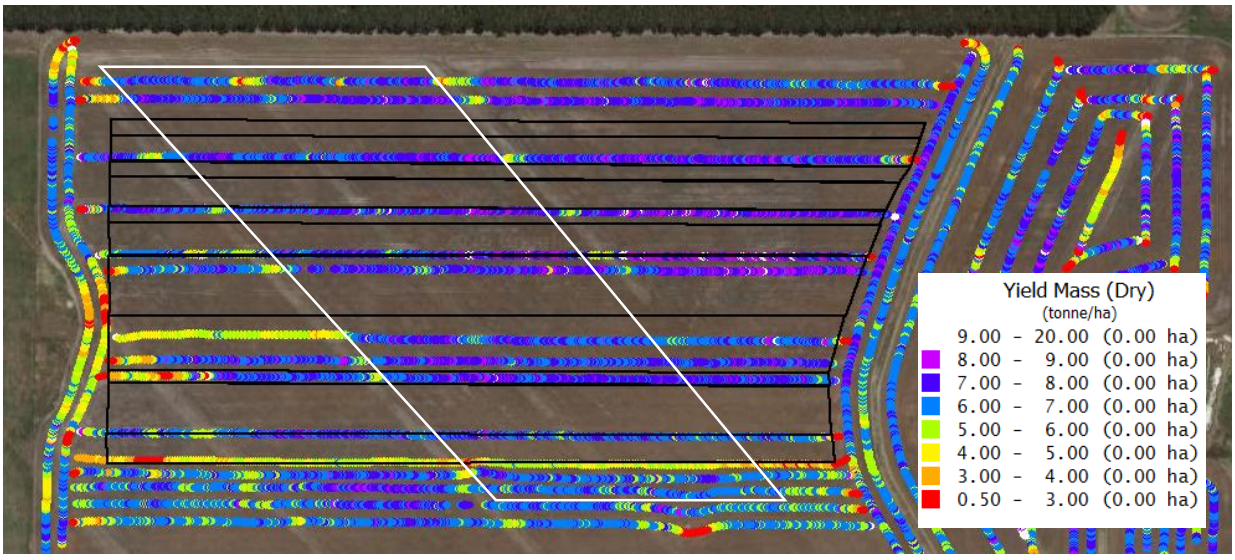

Figure 4. 2019 wheat yield map produced by one of two headers at harvest. Treatment boundaries are overlaid in black, excluding Nil areas on the northern and southern edges. The 'uniform' yield zone between drains is outlined in white. Legend shows raw yields from header.

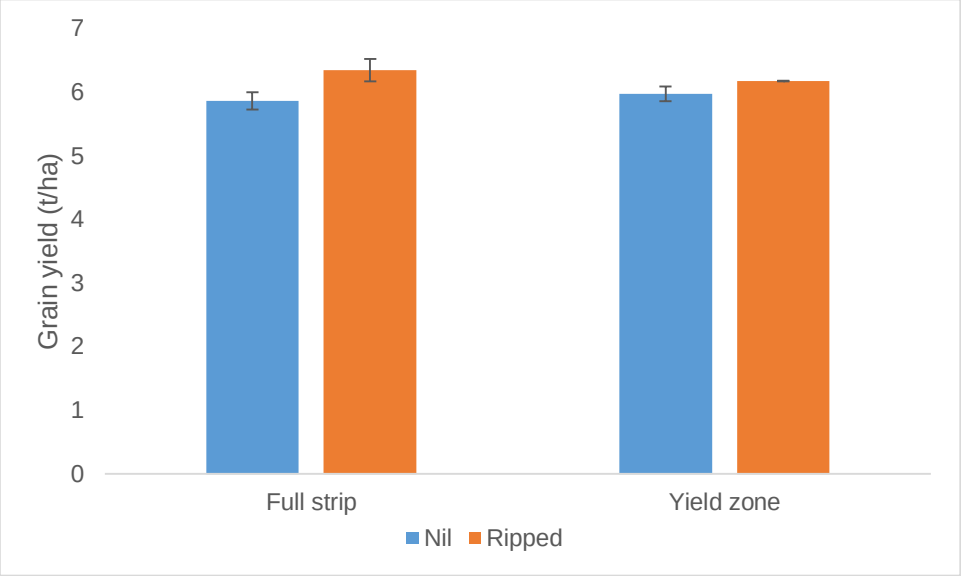

Figure 5. Average grain yield from adjusted header data between Ripped and Nil treatments using two methods; full strip (entire length of trial) and a smaller yield zone (more uniform production zone running between drains). Error bars show one standard error of the mean.

Conclusions

Areas prone to waterlogging did not appear to benefit from deep ripping, however as a decile 1 season, conditions were not conducive to extensive waterlogging. Variability in the dipwell data made it unlikely to find a consistent difference between treatments. We were unable to reliably identify areas of the paddock responsive to deep ripping in the first two years, in terms of grain yield. The lack of replication in the design of this trial and limited yield data means statistical rigour is limited.

Project social media accounts

Twitter: @carla_milazzo

Acknowledgments

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Important disclaimer