Using sowing strategies to mitigate water repellence at Wharminda

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Location
Wharminda
Rainfall
Av. GSR: 252 mm
2022 GSR: 282 mm
Soil type
Shallow sand over sodic clay on carbonate.
Plot size
30 m x 15 m x 3 replicates
Yield limiting factors
Nil

Key messages

- **Crop establishment can be improved on water repellent sands by sowing a little deeper into stored soil moisture.**
- **GPS tracking can help to ensure that seed placement is consistent, however this can have reduced effectiveness when sowing on-row with high stubble loads.**
- **Knowledge of soil characteristics is important for identifying key production constraints and determining an appropriate and effective management strategy.**

Why do the trial?

The Wharminda district of the Eyre Peninsula has large areas of water repellent surface soils that restrict crop germination and growth. This can often result in poor surface cover and increased erosion, particularly in seasons where opening rains for seeding are delayed. There has been some past work to address water repellence in the district with farmers adopting practices such as clay addition, press wheels, stubble retention and split boot sowing. However, these have not always provided an effective solution. There has also been strong interest in previous wetting agent trials at Wharminda and the mitigation treatments at the Sandy Soils research trial at Murlong since 2018. The Hunts trialled a range of treatments to mitigate surface water repellence in 2021 including application of soil wetters at seeding, on row seeding and different sowing system configurations. Results from this trial were inconclusive and the landholders wanted to trial on-row sowing again in 2022 as a potential option to mitigate the impacts of water repellence on crop establishment. Above average summer rainfall resulted in good subsurface moisture, and the Hunts were keen to test the benefits of deeper seeding to improve crop germination.

This trial aimed to identify crop establishment and production benefits from:

- sowing on the previous year's stubble row compared to sowing in the inter-row and,
- sowing deeper into a layer of moist soil.

This article summarises crop growth responses from treatments in the 2022 season. For details of past trial results, see the articles in the 2019, 2020 and 2021 EPFS Summaries (EPFS Summary 2019, p. 99; Validating research outcomes to treat production constraints on sandy soils of Eyre Peninsula and EPFS Summary 2020, p. 84; Treating production constraints on the sandy soils of upper and lower Eyre Peninsula - Year 2 and EPFS Summary 2021, p. 39; Treating production constraints on the sandy soils of upper and lower Eyre Peninsula - Year 3).

How was it done?

In collaboration with AIR EP a replicated trial was established in Wharminda in 2022 as part of the GRDC Sandy Soils project (CSP00203). The site consisted of a shallow sandy rise (120 m long by 60 m wide) in the centre of the trial paddock. Sampling to characterise the soil profile was undertaken on 14 April 2022. Results revealed a water repellent shallow sandy topsoil overlying a light clay B horizon from 20 cm below the soil surface. Carbonate increased with depth, with surface extrusions of hard carbonate (limestone reef) to the south of the trial site.

Treatments aimed to mitigate the impact of surface water repellence on crop establishment and growth, focusing on inter-row vs on-row sowing and the additional impact of two contrasting sowing depths (shallow 5-6 cm and deep 6-8 cm) (Table 1).

Table 1. Summary of replicated trial sites.

Treatment	Treatment Label	Target sowing depth (cm below soil surface)
T1	Off row shallow	5-6 cm
T2	Off row deep	6-8 cm
T3	On row shallow	5-6 cm
T4	On row deep	6-8 cm

What happened?

Treatments were implemented at sowing on 6 May 2022 with the landholder using his seeder (which has GPS guidance capable of sowing on the previous years sowing row) to sow Commodus barley at 70 kg/ha. Samples taken on the previous year's stubble row and in the inter-row at seeding had little difference in soil moisture. The surface layers (0-5 and 5-10 cm) ranged from 1 to 4% soil moisture whilst the subsurface layers (which sit atop shallow clay) ranged from 5 to 8% moisture. Where clay was encountered at 15-20 cm on the western end of the trial (Rep 1), gravimetric moisture at sowing was 13%, on both the previous year's crop row and in the inter-row.

GPS based guidance enabled the seeder to track well between rows on the inter-row sowing treatments. However, sowing on row was difficult to maintain and tynes wandered resulting in a mix of 'on-row' and 'side row' furrows.

Plant density

Plant density was evaluated on 14 June, five weeks after sowing. Despite good summer rainfall and high moisture levels in subsurface layers (below 5 cm), surface soils were generally dry at this time. Crop germination and early growth was generally good with the crop at 3-4 leaf stage at monitoring. Assessments of seeding depth were also undertaken at this time with results indicating that seeding depth was highly variable within treatments (ranging from five to eleven cm below the soil surface), and that the target sowing depth for the treatment was not consistently achieved. Whilst assessments indicated that there was no difference in seeding depth between treatments at the 95% confidence level, the off-row shallow treatment was shallower than where deeper sowing was targeted or where on-row shallower sowing was targeted (which had deeper sowing than the off row deep treatment) at P<0.1. (Figure 1).

All treatments had higher plant numbers at crop establishment than the shallow off-row sowing (P=0.005) (Figure 2).

NDVI/Spring Biomass

Assessments of Normalised Difference Vegetation Index (NDVI) to identify any differences in winter growth were undertaken on 3 August using a handheld Greenseeker. Several crop biomass cuts were taken to calibrate NDVI values against dry matter (t/ha) and the mean NDVI value from four measurements per plot were extrapolated to estimate winter biomass (t/ha of dry matter) (Figure 2). Whilst there was no difference in growth at the 95% confidence level, the deeper sowing on-row treatment increased growth compared to the shallow off-row treatment at P<0.1. There was no difference between the other treatments.

There were no visual differences in growth between treatments in mid-September, and it was decided to take harvest index cuts to assess total biomass rather than spring dry matter.

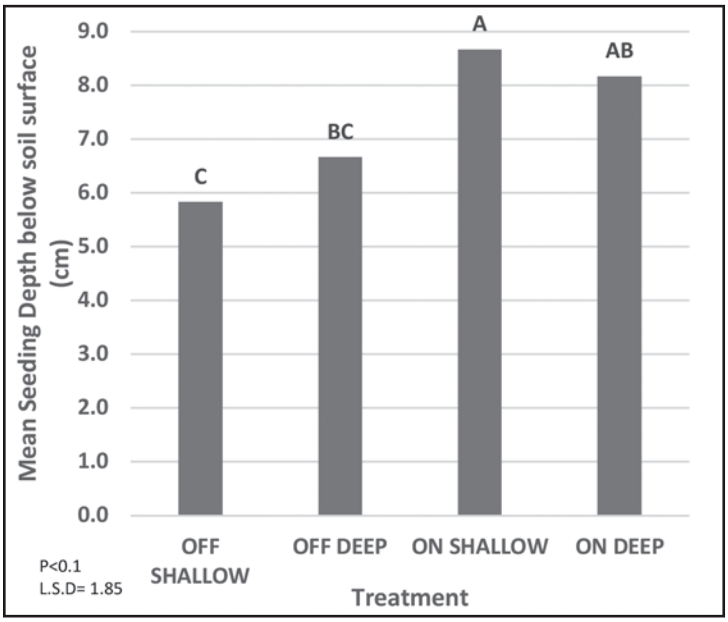

Figure 1. Average sowing depth (cm below the soil surface at Wharminda at crop establishment, 2022 (letters denote significant at P < 0.1).

Soils

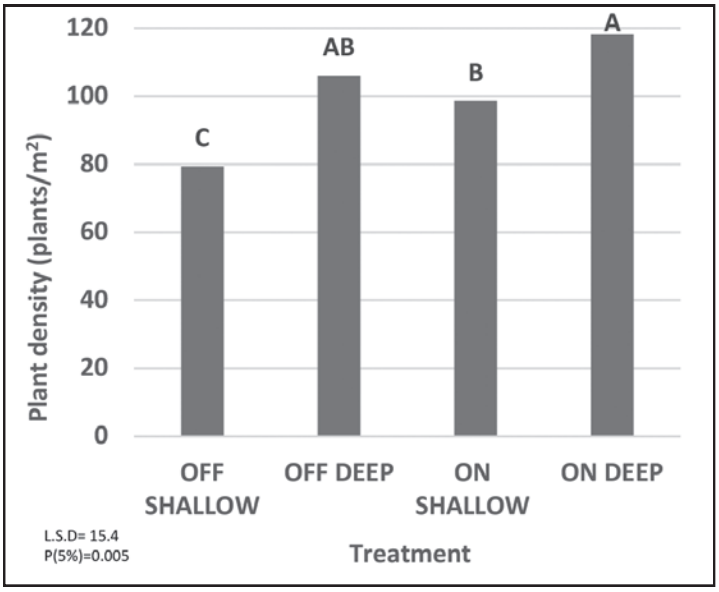

Figure 1. Plants per m² at Wharminda at crop establishment, 2022 (letters denote significant at $P < 0.05$).

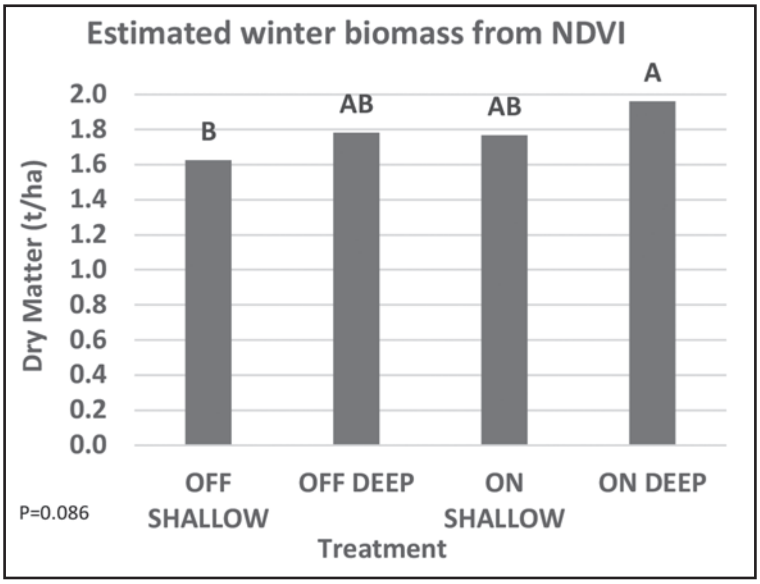

Figure 2. Estimated biomass (t/ha of dry matter) from winter NDVI measurements (letters denote significance at $P < 0.1$).

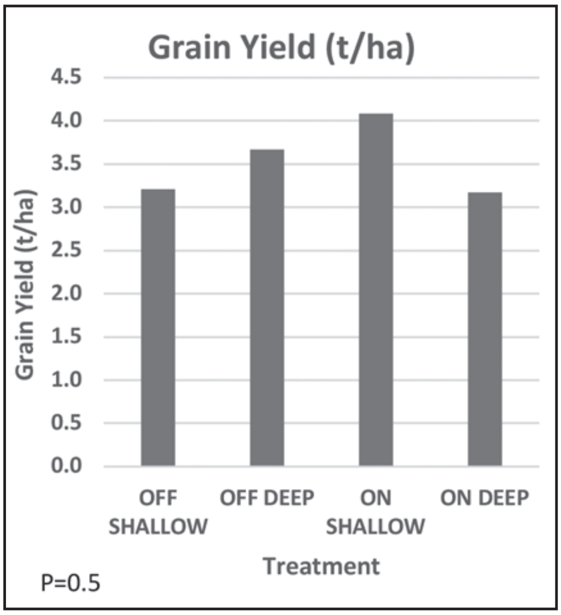

Figure 3. Barley grain yield at Wharminda, 27 October 2022.

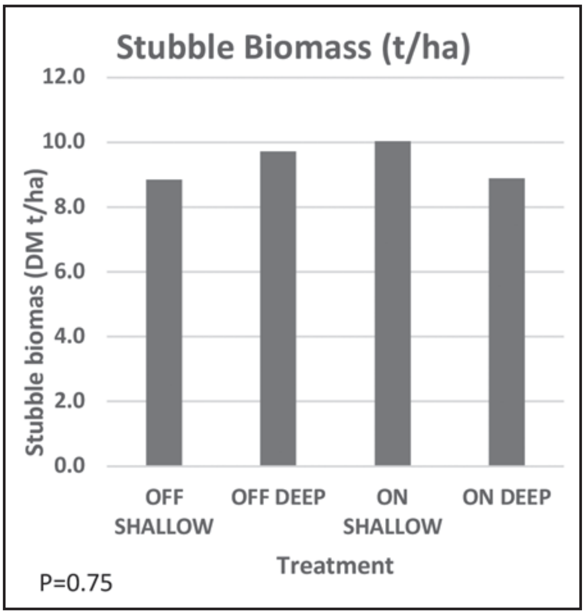

Figure 4. Barley stubble biomass at Wharminda, 27 October 2022.

Grain Yield

Harvest cuts were taken to assess grain yield and total biomass on 27 October 2022. Four cuts per plot were taken to ground level either side of 0.5 m measure. Stubble dry weights were extrapolated to dry matter (t/ha) (Figure 3). Heads were removed and threshed to obtain grain weights which were extrapolated to grain yield (t/ha) (Figure 4). Despite differences in crop establishment and some small crop growth benefits from deep seeding (at 90% confidence) there was no significant difference between treatments in the grain yield and stubble biomass.

What does this mean?

Good summer rainfall resulted in high subsurface moisture at seeding. This provided the ideal opportunity for the Hunts to trial deeper sowing as a strategy for managing soil water repellence. GPS seeder tracking was broadly effective in facilitating inter-row sowing, but the sandy nature of the soil and standing stubble reduce the accuracy of this when sowing on-row. This affected sowing depth, with only 1-2 cm difference between the sowing depth for the off-row shallow and off-row deep treatments.

Assessments of sowing depth also suggested that the average sowing depth on the on-row shallow treatment was deeper than where deeper sowing was targeted (but sowing depth on this treatment varied greatly from 5 to 11 cm and the mean sowing depth for the treatment might not accurately reflect the combined effect of shallow on-row sowing). All treatments had in increased plant numbers compared to the off-row shallow sown treatment.

Winter and spring rainfall provided good conditions for crop growth and the differences between treatments seen at crop establishment were not present later in the season. Despite no difference in biomass production and grain yield in 2022, trial results suggest that where surface soils are dry but subsurface layers contain moisture, sowing deeper can improve crop establishment on water repellent soils. Having high plant numbers at crop establishment has multiple benefits including improved surface cover for wind erosion protection and providing early vigour for improved crop resilience in poorer seasons. Whilst long coleoptile varieties will provide excellent options for deep sowing on these soils, results from this trial indicate that if surface soils are dry and subsurface layers contain moisture, sowing an extra 1-2 cm deeper can be helpful for early crop establishment even with commonly grown varieties.

Acknowledgements

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