One-pass ‘plough and sow’ and ‘spade and sow’ techniques to overcome water repellency and improve crop establishment

CASE STUDY 12

SNAPSHOT

Location: Cowangie, Vic
Enterprise: Cropping
Average annual rainfall: 320-350 mm

KEY MESSAGES

- One pass ‘spade and sow’ or ‘plough and sow’ can successfully improve water repellence and crop establishment.
- Maximising crop establishment and early ground cover is critical to optimising cropping success and minimising soil erosion risks in highly exposed sandy areas.

INTRODUCTION

The demonstration site was established in April 2022 on a sandy soil near Cowangie, in the Victorian Mallee. The aim of this trial was to demonstrate one pass soil amelioration techniques, which mix the soil to dilute surface water repellence, while simultaneously establishing a crop to reduce the post amelioration erosion risk. Overcoming non-wetting will improve crop establishment, leading to higher and more consistent productivity.

This site demonstrated two contrasting one-pass soil amelioration and crop sowing techniques (i.e. ‘spade and sow’ vs ‘plough and sow’) on a low productivity and exposed water repellent sand hill. Their performance was compared to un-ameliorated control areas surrounding the demonstration site.

SANDY SOIL CONSTRAINTS

Non-wetting | Compaction | Low fertility

Trialled

- One pass ‘spade and sow’
- One pass ‘plough and sow’

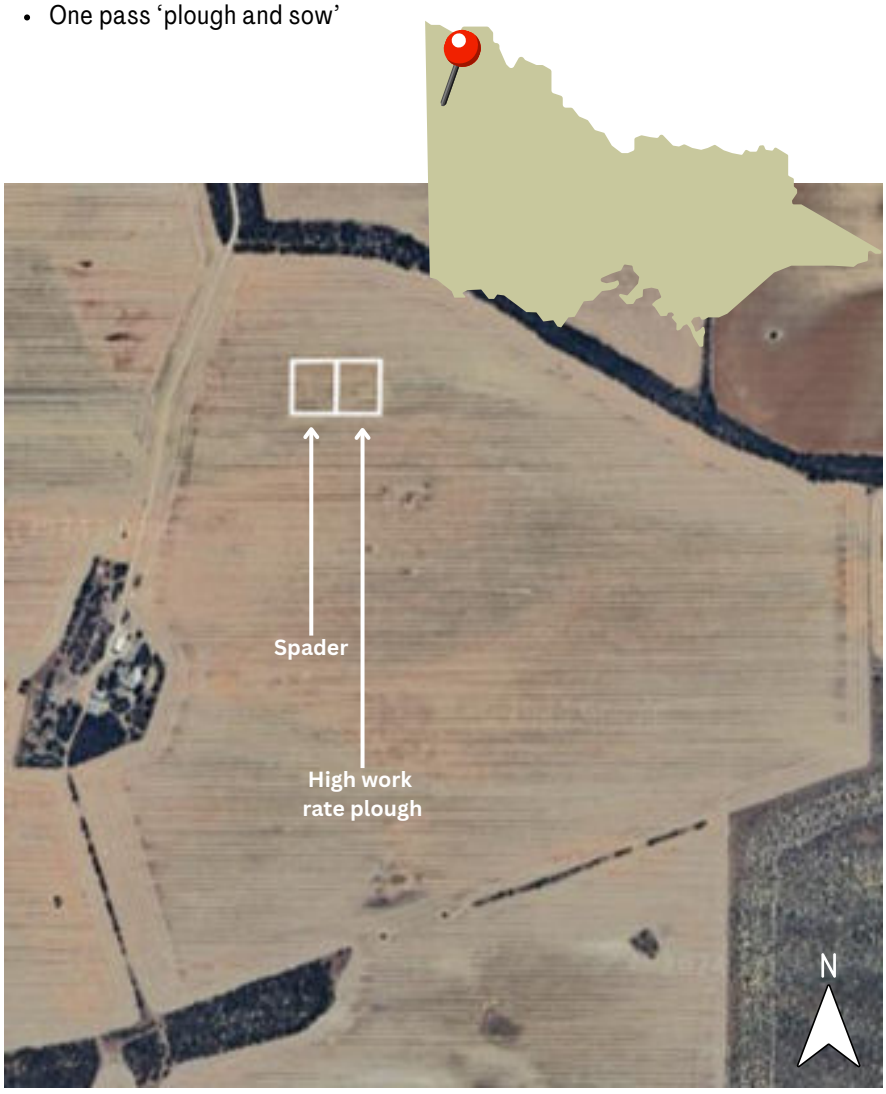

Figure 1. Location and size of the two trial areas shown as the white squares within the paddock.

INTRODUCTION cont...

Soil constraints

Soils on the farm vary from heavy calcareous soils with limestone, up to good deep red loams and white sandy water repellent soil. The trial site soil was sandy to depth. Soil pH was slightly acidic in the surface soil (0-10 cm) but neutral to slightly alkaline in the subsoil layers. Soil fertility was generally low, with an organic carbon level of 0.5%.

The surface soil was moderately water repellent, with a molarity of ethanol droplet (MED) reading of 1.5.

THE TRIAL

To improve water repellence and crop establishment, two treatments were tested:

- Farmax Rotary Spader, mixing to 350 mm depth
- John Shearer High Work Rate Plough (HWRP), mixing to 420 mm depth

Both machines treated one hectare (Figure 1) at a 5.5 km/hr working speed.

Both treatments were implemented as a one pass 'spade and sow' or 'plough and sow' operation where the crop was sown at the same time as the soil was ameliorated. The 'spade and sow' system seeded the crop using an integrated seeding system with 30 cm row spacing with seed and fertiliser delivered from a tow-behind air-cart. The 'plough and sow' treatment was sown on 25 cm row spacings using a high floatation towable drill.

Treatments were implemented and the site sown to barley on 10-11 May 2022. In 2023, the area surrounding the trial site was deep ripped, however both the spading and high work rate plough trial areas were not ripped. The site was again sown to barley in May 2023 using the farmer's seeder.

RESULTS

Water repellence

Water repellence was overcome using the spader and HWRP with an MED of 0 recorded in the topsoil following both treatments.

Table 1. Crop establishment summary plants/m^2

	Spade	Plough	Control*
2022	88	114	40
2023	76	73	53

*No treatment in 2022 crop, ripped at end of 2022

Crop establishment

2022

The 2022 season recorded the wettest Autumn since 1983 (131 mm over March to May), which reduced crop establishment challenges. This season followed a very dry 2021 sowing (19 mm over March to May) with strong water repellence expression. However, despite the favourable conditions for crop establishment in 2022, there were significant benefits from using both soil amelioration systems.

Both the 'plough and sow' and 'spade and sow' systems established quickly, with crop establishment of 88 plants m^2 (74%) with plough and sow, and 114 plants/m^2 (97%) with spade and sow (Table 1). Crop emergence in the adjacent untreated paddock was roughly half to one-third of the trial plots, with just 40 plants/m^2 (41%).

2023

Barley was sown in May 2023, with rainfall received approximately four days after sowing. Observations one week after sowing were that:

- The spaded area appeared the most advanced at 3-leaf, but with similar plant density to ploughed area.
- The 2023 ripped control plants had staggered germination with smaller seedlings and some were still emerging due to uneven wetting.

Two months after sowing, crop emergence in the 'spade and sow' and 'plough and sow' plots were 30% higher than the surrounding deep ripped paddock (Table 1, Figure 2 right).

In the deep ripped soil, emergence was twice as variable, and barley plants were smaller and germinated later than the spade/plough and sow plots (Figure 3).

FARM OPERATORS COMMENTS

- Establishment, biomass and weed control benefits were obvious. There was brome grass outside the trial area but no evidence of populations in the trial plots, indicating the spading and ploughing buried the weed seeds.
- Spading mixed the soil better than ploughing. Digging into the soil showed roots in the ploughed plot following the lines of good sand.
- The one-pass approach is impressive, but the technique is not well suited to the large areas that need treating (up to 16,000 ha/yr).
- To address water repellence on the hills, would consider spading over ploughing.
- There did not appear to be post-amelioration issues with soft soil.

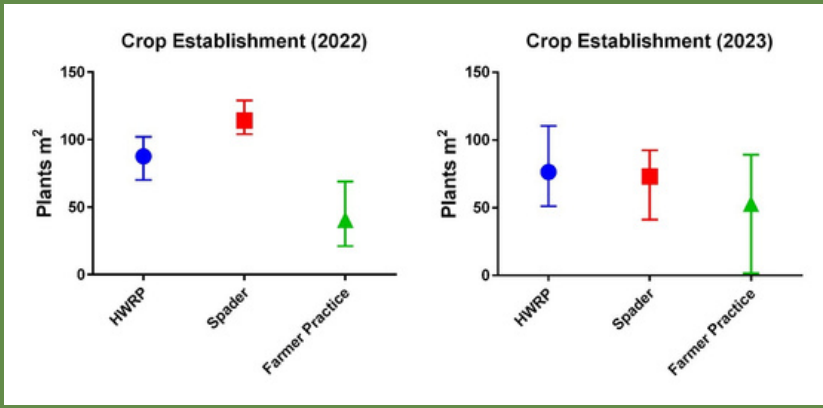

Figure 2. Barley establishment in the treatments where the HWRP and spader were used in 2022, compared to the establishment in farmers paddock immediately adjacent to the treatment areas.

Figure 3. Early 2023 crop establishment visual at 2+ weeks on 2022 ploughed area (left) vs 2023 ripped control (right).

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RESOURCES

AgriKnow: https://www.agriknow.com.au/trial/42

PROJECT INFORMATION

Trial run by Michael Moodie, Frontier Farming Systems.
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Building drought resilience by scaling out farming practices that will enhance the productive capacity of sandy soil landscapes.
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