SEEDING SANDY SOILS FACT SHEET

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

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Managing water repellence at seeding: moisture access strategies

Photo: Jack Desbiolles

Paddock adoption of row-guided sowing with large-scale machinery needs accurate autosteer guidance and reliable seeder tracking stability.

KEY POINTS

- Crop establishment in water-repellent sands can be improved by accessing soil moisture available after the opening rains, either within the stubble row or in the inter-row subsurface below the dry layer (up to 20 centimetres (cm) deep)
- On-row or edge-row sowing and deep moisture lifting achieved consistent benefits in small plot trials
- Combining these techniques with a seed zone soil wetter maximised the benefits
- Angled-row sowing is a practical compromise when accurate row-guided seeding cannot be implemented
- Seed and fertiliser separation can provide complementary benefits

Best practice

Maintaining surface ground cover is critical in sustaining productivity and managing both erosion and weed risks on water-repellent sandy soils. Current seeder strategies to improve crop establishment on water-repellent sands include:

1. maximising access to available soil moisture following opening rains;
2. minimising competition for moisture within the seed zone;
3. maximising furrow water-harvesting capability; and
4. combining all the above with a soil wetting agent.

This Fact Sheet summarises strategies 1) and 2), while 3) and 4) are addressed in a separate Fact Sheet (*Soil Wetter* – see Useful Resources section).

Rainfall infiltration

Rain falling over a non-wetting soil surface forms run-off, which flows towards low-lying zones such as remnant press-wheel furrows, machinery wheel ruts or livestock footprints, then infiltrates preferentially via existing root system pathways. In addition, standing stubble helps capture and channel rain to the base of the root system in the furrow resulting in moisture accumulation below existing stubble rows with inter-row zones remaining dry. As the soil becomes

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wettable at depth, the moisture gradually equalises across from the stubble row to the inter-row zone (Figure 1: Top).

At three water-repellent sites in 2018-19, an equivalent 7 to 9 millimetres (mm) of extra moisture was measured in the 0 to 40cm depth zone under stubble rows after opening rains.

Soil moisture access

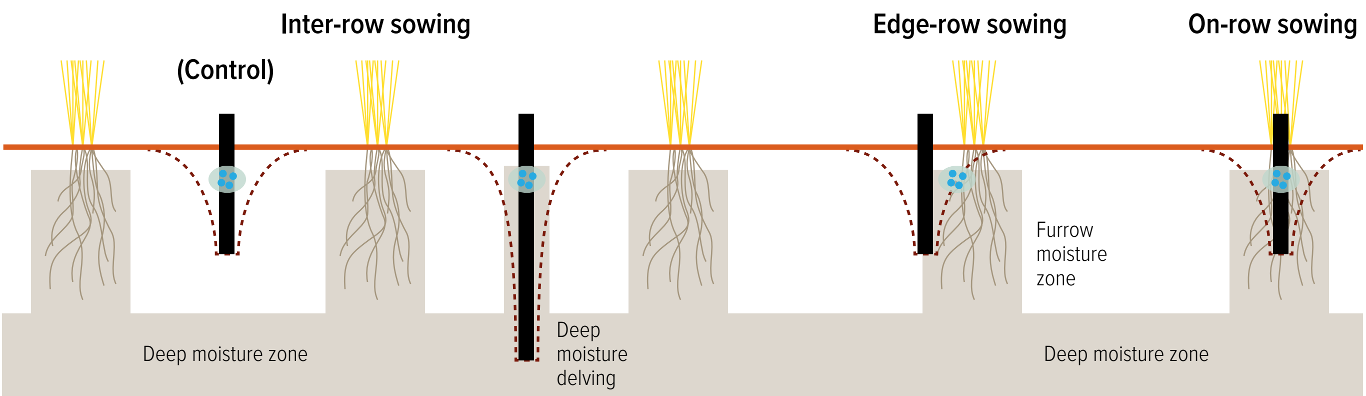
The above wetting process leads to opportunities at seeding time for strategies depicted in Figure 1: Top, such as:

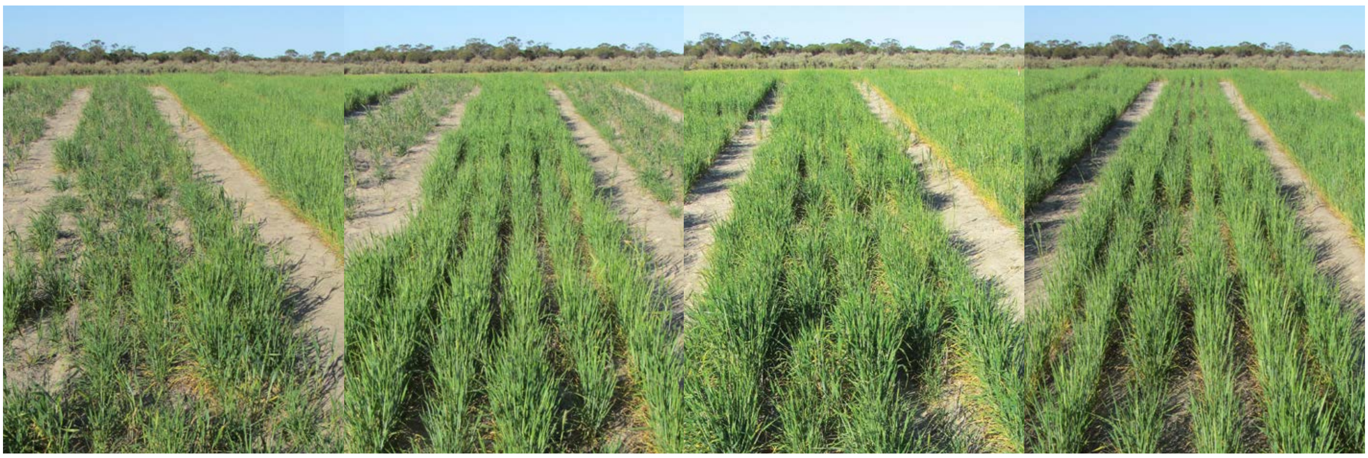
- placing seeds into available stubble row moisture using edge-row or on-row sowing techniques. In both cases, real-time kinematic (RTK) positioning accuracy via tractor autosteer is required, sometimes complemented with implement steering, together with a stable-tracking seeder bar. Although edge-row sowing maintains stubble row integrity, it is challenging in practice (see page 3). On-row sowing is both easier to achieve and most effective at improving seed germination. However, with tyne seeders, the technique fully uproots stubble rows and leads to residue clumping and potential blockages, while with disc seeders significant crop establishment losses can arise from residue hairpinning. Overall, on-row sowing is less impactful when implemented into pulse stubble. Crops sown into higher moisture furrows also benefit from improved mineral fertiliser availability, greater N mineralisation and potential root disease suppression from more active microbial activity; and
- lifting deep soil moisture up into the seed zone by using long-reaching openers set at a low rake angle. This moisture-delving option requires independent seeding row units with press-wheel regulated seed delivery where a deeper furrow can be adjusted on-the-go over water-repellent zones to restrict the high draft overall penalty while not significantly affecting seed placement.

Field evidence of benefits

In a replicated small plot trial at Murlong (SA Eyre Peninsula) in 2019, the above techniques (edge-row/on-row sowing and inter-row sowing with deeper moisture lifting) combined with a soil wetter applied in the seed zone were able to significantly increase barley crop establishment by 70 to 75 plants per metre squared (m^2) relative to the baseline inter-row sowing with soil wetter, which established 28 plants/m^2 (see Figure 1: Bottom). The benefits were maximised (Figure 2) with an additional 92 plants/m^2 under on-row sowing with soil wetter, using a paired-row wing attachment, compared with the baseline treatment (Desbiolles et al. 2020).

Figure 1: Top: Conceptual representation of moisture zones under stubble rows merging with deeper wetted layer (shaded), after opening rainfall on a water-repellent soil, and possible seeding techniques that can be used to access this moisture. Bottom: Corresponding barley crop establishment snapshots (inclusive of seed-zone soil wetter) at 14 weeks after sowing (2019 – Murlong field trial).





Photos: Jack Desbiolles

Figure 2: Best-established barley crop snapshot at 14 weeks after sowing in a severely water repellent sand at Murlong, 2019, from on-row sowing using a paired-row opener with soil wetter delivery to each outlet (right). After 174mm of growing season rainfall, this treatment yielded 2.4t/ha relative to a 1.0t/ha grain yield under the control (inter-row sowing with wetter, Figure 1 – left).

Photos: Jack Desbiolles

Similar barley crop establishment benefits (increase of 67 to 75 plants/m^2) from on-row sowing with or without deep moisture lifting were validated (without a soil wetter) under a replicated small plot trial at Younghusband (SA Mallee) in 2021, relative to an inter-row sowing baseline, which established 23 plants/m^2.

Edge-row sowing challenges

Edge-row sowing requires greater guidance accuracy than inter-row sowing and is especially reliant on seeder tracking stability. In 'up/back' sowing operations, there is a need to manually nudge the AB-line when changing direction to remain accurately on track, which is cumbersome and complicates sowing in subsequent years. To avoid this limitation, two alternative techniques compatible with a constant AB-line annual setting can be used, namely:

1. edge-row sowing on annual AB-lines using paired row seeding systems. This is the most commonly adopted scenario but allows only one side outlet of paired row seeding to benefit from stubble row moisture. The AB-line is offset annually by an amount to suit the width of the paired row attachment and the position of the stubble row from the moisture-benefiting outlet. For instance, to suit 75mm wide paired row wings on a tyne seeder, edge row sowing in Year 1 requires the AB-line to be offset one way by 60 to 70mm and the following year this offset corrected by 90 to 100mm the other way. This process is repeated on a two-year cycle; and

2. edge-row sowing on constant AB-line using a side-banding system and adjusting the tyne positioning from year to year. This approach is more cumbersome, more practical with small seeders, and requires sufficient tool bar space, but allows all seeds to be delivered into stubble row moisture. For instance, to suit 35mm offset side banding wings symmetrically fitted, facing inwards on a tyne seeder, edge row sowing in Year 1 requires all tynes to be shifted outwards by 35mm, then in Year 2 the tynes are shifted inwards by twice this amount (70mm), while left-hand and right-hand wings are swapped over across the seeder. In Year 3, the tynes and wings are returned to the original positions and directions. This process is repeated on a three-year cycle.

With the above, it is always recommended that annual sowing maintains the same seeder path in each paddock. Seeder bars with limited tracking stability may sometimes pull back into the old furrows but active implement steer can help mitigate this issue.

Angled-row sowing

In situations where seeder tracking is poor due to design limitations, soil variability, paddock topography or shape, sowing at an angle to existing stubble rows allows for placement of seeds into some moisture when crossing stubble rows. This simplified strategy is not compatible with controlled-traffic farming and typically produces wavy crop establishment patterns (Figure 3) but ensures some early ground cover is achieved and soil erosion risks are mitigated. Research is yet to explore the impact of furrow opener designs and angle of approach relative to the stubble rows on optimising crop establishment performance.

Figure 3: Angled-row sowing: Banded pattern of crop establishment from sowing at a 10° angle to the stubble row direction reflects the crossing of previous year rows.

Photo: McGlasson Rural Systems

Fertiliser toxicity

When soil moisture is marginal or uneven in a water-repellent sand, the risks of fertiliser toxicity to the seed are increased. Fertiliser toxicity (IPNI, 2013) consists of:

- the osmotic or 'salt effect' inducing competition for soil moisture, causing potential seedling dehydration and death. Concentrated fertilisers (high 'salt-index') placed close to the seed maximises risk, while lower application rate and higher seedbed utilisation dilute exposure; and
- ammonia toxicity from urea (and potentially from ammonium-containing fertilisers in high pH soils) occurs as a 'gas plume', which is toxic to both seeds and roots.

These effects are more likely on sandy soils compared with loams or clays and therefore can variably affect different parts of a paddock, such as in swale-dune systems. Under these conditions, split-banding fertiliser away from the seed zone consistently improves seed germination rate. The rist of toxicity is mitigated if sowing is followed by significant rains; however, a 50mm vertical separation between seeds and fertiliser eliminates issues in most situations, while a lateral separation is also required where ammonia toxicity is possible. Particularly sensitive crops such as canola, lupins and lentils benefit from minimal or no fertiliser placed in the seed zone under a marginal soil moisture situation. Seed and fertiliser separation implies greater furrow disturbance, which combines well with deep moisture lifting technique.

USEFUL RESOURCES

GRDC fact sheet: ***Diagnosing Sandy Soil Constraints: Water Repellence and pH*** (2022). grdc.com.au/diagnosing-sandy-soil-constraints-water-repellence-and-ph-south-west

GRDC fact sheet: ***Soil Wetter*** (2022). grdc.com.au/soil-wetter-national

GRDC fact sheet: ***Fertiliser Toxicity*** (2011). grdc.com.au/resources-and-publications/all-publications/factsheets/2011/05/fertiliser-toxicity

Desbiolles (2017). **Seeder tracking and guidance for precise row sowing**. protrakker.com/news-and-events/03-08-17-seeder-tracking-and-guidance-or-precise-row-sowing

Mortvedt (2018). **Calculating salt-index. Spectrum Analytic**. spectrumanalytic.com/doc/library/articles/salt_index_calculation

REFERENCES

Desbiolles et al. (2020). ***Seeder-based approaches to reduce the impact of water repellence on crop productivity***. GRDC Update Paper. grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2020/02/seeder-based-approaches-to-reduce-the-impact-of-water-repellence-on-crop-productivity

IPNI (2013). **Care with fertilizer and seed placement**. anz.ipni.net/article/ANZ-3076

MORE INFORMATION

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