MSF Robust Ground Cover

KEY MESSAGES

"Developing Robust Ground Cover to Enable Resilience in Low Rainfall Mixed Farms," led by Mallee Sustainable Farming (MSF), explored and advanced in-field proof-of-concept work through approaches to building soil resilience. The project was supported by the Australian Government's Future Drought Fund.

Different treatments were investigated on the basis of their ability to contribute to the following crop resilience cycle:

Prepare and Promote - crop establishment uniformity:

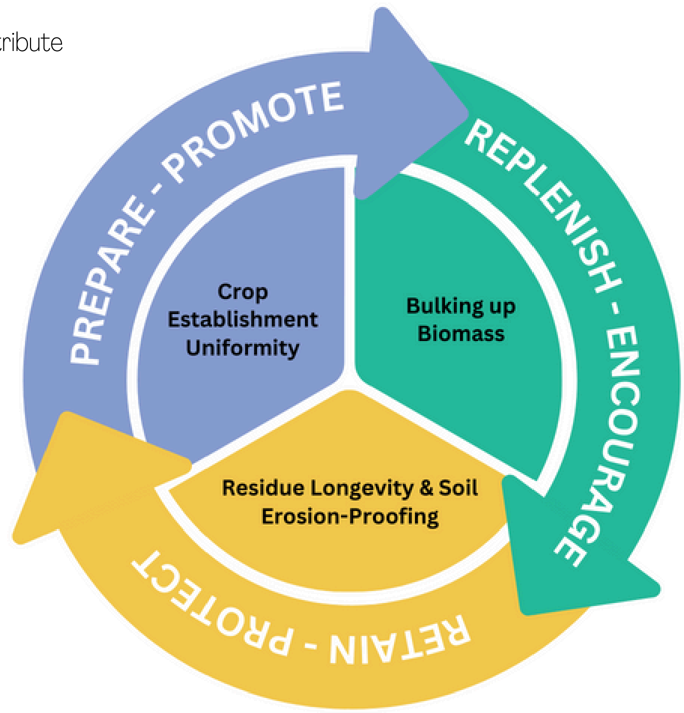
1. Long coleoptile wheat
2. Seed priming
3. Disc seeding

Replenish and Encourage - bulk up plant biomass:

4. Low risk residue friendly strip amelioration practices

Retain and Protect - residue longevity & soil erosion proofing

5. Stripper front harvesting



Trials were conducted at multiple sites across South Australia, Victoria, and New South Wales, including Waikerie, Lowaldie, Cootra, Cockaleechie, Wharminda, Manangatang, Wentworth, and Werrimull. These locations provided a range of soil types and farming systems to evaluate innovative strategies for improving ground cover, crop establishment, and soil resilience in low rainfall mixed farming systems.

This fact sheet outlines the key messages and outcomes from each area of investigation. A more detailed summary of the trials can be found at XX.

1. LONG COLEOPTILE WHEAT

Long coleoptile wheat varieties can germinate from deeper in the soil than their conventional counterparts. By sowing deeper into residual summer moisture, crops can access water immediately. Other benefits include sowing beneath a non-wetting soil layer, better crop emergence when seeding depth is harder to control, such as after mechanical soil amelioration, and seeding deeper to avoid pre-emergent herbicides. These trials aimed to evaluate how long coleoptile wheat varieties perform when sown at various depths, particularly under challenging soil and climatic conditions.

Earlier shoot and root growth on deep sown (12 cm, right) compared to shallow sown (4 cm left). Photo: CSIRO.

Key Messages and Outcomes

- Deeper sowing often provided early establishment benefits (around 4 weeks) but these did not translate to biomass or yield benefits.
- Conventional and long coleoptile varieties performed similarly in most cases.
- Success depended on soil type and moisture conditions. Long coleoptile genetics can be used to aid crop emergence if sowing very deep to chase moisture. If soil moisture is good, deeper sowing is not necessary.
- Based on modelling, sandier soils are more suited to deeper sowing since moisture can infiltrate further and is less likely to remain near the surface, especially in years with dry fallows.
- Deeper sowing offers fewer benefits in higher rainfall regions, as rainfall is more reliable in late April and early May, allowing shallow soil moisture to support crop establishment.

Picture source: https://medium.com/plant-cell-extracts/plants-the-green-starfish-of-the-world-df3c9c22ff7a

2. SEED PRIMING

Seed priming - soaking the seed before sowing - aims to initiate the early stages of germination. The process reduces the amount of moisture needed to complete germination, meaning that seeds can germinate faster and more uniformly once sown and can germinate in lower soil moisture than normal. On sandy, non-wetting soils, seed priming could help establish more vigorous groundcover in drier seasons and provide an increased yield potential. Two trials investigated if seed priming could improve crop establishment in low rainfall conditions.

Laboratory seed soaking at Minnipa (left, middle). Photo:SARDI; primed lupins vs dried lupins (right). Photo: UniSA

Key Messages and Outcomes

- Priming enhanced early wheat germination but did not consistently improve final crop establishment or yield.
- Priming had a small but significant impact on lupin emergence. It did not improve emergence in lentils.
- The concept of imbibing seeds with water to initiate germination without full germination has proven challenging in low-rainfall systems. Once sown, primed seeds may lose absorbed water to dry or rapidly drying soil, negating the benefits of priming or even causing issues if seeds are prematurely committed to germination.
- Optimal results may require primed seeds to be sown deep within a well-insulated seed zone that maintains high relative humidity to minimise moisture loss. This approach could be more compatible with long coleoptile wheat varieties designed for deep sowing.

3. DISC SEEDING

Disc seeders are designed to retain more ground cover, minimise soil disturbance, and conserve soil moisture. However, they can pose challenges, including difficulties with weed control (such as herbicide damage to crops), disease management—especially after a dry summer fallow when residue decomposition is slow and inoculum from the previous season persists—and issues with crop establishment.

Multiple trials were conducted at Manangatang, Wentworth, and Lowaldie to evaluate the effectiveness of disc seeding in low rainfall regions. These trials compared disc seeding with traditional tyned systems, examining crop establishment, stubble retention, and herbicide management for pulse crops and cereals.

Gent Angled Double Disc | Root Boot Razor Disc | Serafin Baldan Single Disc

Photos: Frontier Farming Systems

Key Messages and Outcomes

- Disc seeding preserved stubble, reduced soil disturbance and conserved soil moisture, but challenged crop establishment, especially on sandy soils and in legumes.
- Early season crop damage from herbicide treatments was common but, in favourable growing conditions, the damage was overcome by the end of the season.
- Crops in sandy soils were particularly prone to herbicide damage in disc sown systems; careful herbicide selection and application are crucial.
- Disc seeders with greater disturbance (throw between rows) reduced the risk of damage from herbicides incorporated by sowing.
- Early post-emergence herbicide applications reduced damage but required rainfall to be effective.
- Despite residue benefits, reduced growth and production resulted in less new groundcover being recruited during the legume phase. This was evident at both Wentworth and Meringur in 2023 where lentils and field peas sown with disc systems produced significantly less green vegetative ground cover than crops sown with the tyne systems.
- Taller standing stubble and increased harvest losses from a 'strip and disc' system and harboured mice. Pest monitoring and control needs to be managed to avoid crop losses.
- When applying fungicide to treat Rhizoctonia with disc seeding system, split applications (topsoil and into furrow) worked best.
- The low footprint disc seeder demonstrates promise but needs more work at bigger scale and under different conditions.

4. STRIP AMELIORATION

Strip amelioration allows growers to ameliorate paddocks in stages while maintaining functional ground cover. Strip amelioration works a portion of the paddock by leaving alternating strips of ameliorated soil and undisturbed standing stubble. This approach balances the need for soil improvement with maintaining protective ground cover. These trials in Lowaldie, South Australia, compared active inclusion ripping (ripping with inclusion plates) and single pass delving and disc seeding on a non-wetting sandy rise.

Strip ripping leaving strips of standing stubble. Photo: UniSA

Key Messages and Outcomes

- Ameliorated strips improved relative crop growth and yield during tight seasons.
- Strip amelioration reduced erosion risk compared to whole-paddock amelioration, by retaining standing stubble strips.
- Strip amelioration with blanket sowing required a willingness to manage non-uniform crop maturation.
- Strip spading and sowing in a single pass provided the basis for a safe strip cropping option in the first year and addressed issues with trafficability.

5. STRIPPER FRONT HARVESTING

Stripper front harvesting uses a specialised header front that 'strips' the grain heads while leaving tall standing stubble. This method aims to minimise soil disturbance and maintain ground cover. These trials compared various stripper front setups and operating speeds on combine throughput and harvester losses.

Tall wheat stubble after harvesting with the Shelbourne Reynolds stripper front (Left) compared to stubble after harvesting with a conventional draper front (right) near Manangatang in the Victorian Mallee. Photo: Frontier Farming Systems

Key Messages and Outcomes

Given the seasonal challenges of the single year harvest trials carried out in this project, there has not been chance to determine if stripper fronts are a more suitable option in low yielding Mallee crops. However, there are some tips if using:

- Stripper fronts retained stubble effectively but required careful speed and settings management to minimise crop loss.
- Higher speeds of stripper front harvesters (above 11 km/hr) generally do not increase losses compared to lower speeds. Higher speeds are recommended to make the most of harvester capacity and maximise work rate.
- Low hood settings are detrimental in high density crops.
- Harvesting across the crops was not beneficial and was, in some cases, detrimental compared to harvesting along the row.
- Stripper fronts should be avoided in shedding prone crops and varieties.
- The stripper fronts almost always led to more grain losses than a conventional open front. However, losses should be weighed against the benefits of increased standing residue, moisture conservation and harvest efficiency (potential higher speeds).
- Taller standing stubble can harbour mice.
- Consider the header driver's preparedness, concentration, and the numerous adjustments required with the stripper front, as well as the need to swap fronts during the season to suit the crops in rotation.
- Using a stripper front requires a systems approach as it affects grain transport and logistics. Doubling capacity means grain must be promptly carted to avoid bottlenecks, and managing two fronts adds challenges for transport and maintenance.

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