farmtalk

Mallee Sustainable Farming

This article contains infomation most relevent to the less than 350 mm rainfall mallee farming regions

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SEEDING SYSTEMS FOR VARIABLE MALLEE SOILS

Getting the seeder set-up right is critical for rapid seed germination, uniform crop emergence and good early crop vigour. This FarmTalk addresses ten considerations in choosing and setting up a seeding system for effective use in Mallee paddocks.

1 Seeding systems for variable soil types

One of the greatest challenges Mallee farmers encounter is the inability to maintain a consistent and accurate seeding depth across all soil types. As a result crop establishment is often variable with crops sown too shallow on stony soils and too deep on soft sandy soils.

In 2014, eight double shoot seeding systems were evaluated at a site with three common soil types (stony, mid-slope and sandy rise) at Murrayville, Vic. Selected results are shown in Figure 1.

Under favourable soil moisture conditions including 29mm post-sowing rainfall, the two paired row systems out-performed most other seeding systems across all soil types, by improving emergence in stones and on the sand hill. Similar benefits were measured in the stones with an independent press-wheel regulated seeding system. All systems evaluated performed equally well on the mid-slope soil.

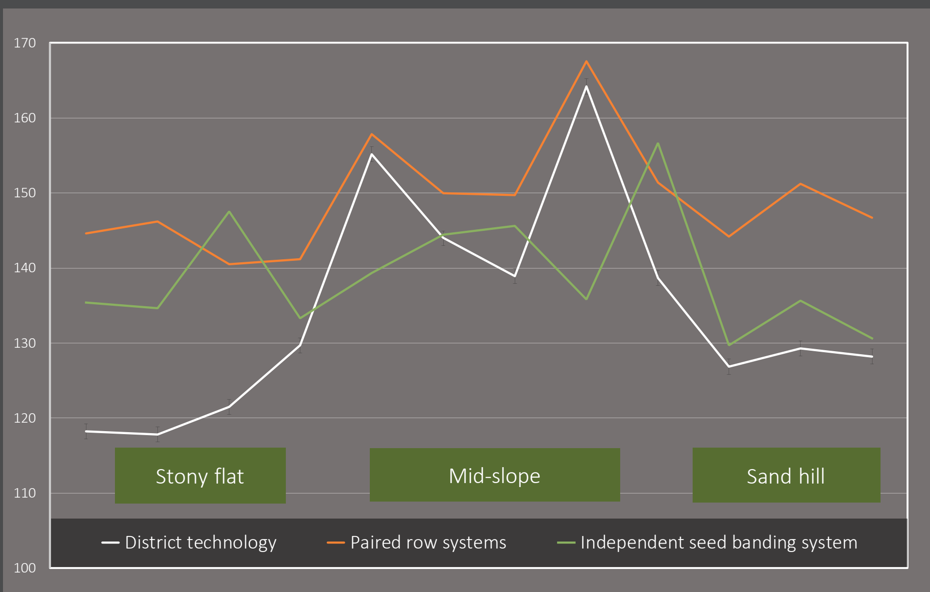

Figure 1: Wheat establishment (plants/m^2) across 3 soil types at Murrayville in 2014 (District technology: simple tine with knife point, rubber seed boot and press wheel)

2 Considerations for paired row systems

The use of paired-row or split-row systems and spreader seed boots has increased in recent years, with the aim of improving seedbed utilisation (SBU) at an existing row spacing. Paired row and spreader boot systems fall into two different categories:

i) Placement of seeds on undisturbed soil, with or without a deep-till centre furrow. These systems often consist of compact designs integrated behind the furrow opener, which may provide improved access to sub-surface moisture and promote superior seed germination in marginal moisture situations.

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i) Placement of seeds in loose furrow backfill. These typically lower cost systems aim to maximise seed spread within the available furrow shape and size, and often operate further behind the opener. These systems are less suitable in marginal moisture situations as furrow backfill moisture is diluted and subject to high drying rates. They are sometimes more prone to residue-catching and can face difficulties with achieving sufficient seeding depth.

Under equal crop establishment and SBU, all paired-row and spreader boot systems should have similar potential to enhance grain yield, improve competition with weeds and reduce fertiliser toxicity risk.

Potential disadvantages of paired row and spreader boot systems include:

- Not as suitable for larger or awned seeds due to smaller opening size.
- Higher risk of blockage in sticky conditions.
- Higher soil disturbance, with reduced crop safety for category ii) systems
- Potential for a more variable depth of seed cover across the paddock, but this can be mitigated by contour-following technology.

3 Optimising performance in stony soils

Stony soils present a significant challenge for seed placement and crop emergence as it can be hard to strike the balance between preventing machinery damage and securing accurate placement. A key consideration when seeding into stones is how to best manage the intense breaking-out of the seeding system units. Best practice is to use a high break-out force combined with seeding at shallow tillage depth.

Deep seeding with high break out force is unsuitable as it results in excessive paddock roughness and often poor seed placement accuracy. Paddock roughness is minimised with tine seeders by using steep rake angle narrow openers, or with the use of a disc seeder.

To improve seeding performance and seeder durability in stones, growers should consider:

Tine seeders:

i) Hydraulic release system,
ii) Shallow tilling depth setting,
iii) Compact seed and fertiliser banding unit,
iv) Low operating speed (5-6 km/h), and
v) Stone-grade, tungsten carbide opener protection.

Press-wheel-regulated, independent seed boot systems offer a flexible option allowing furrow tillage depth to be changed on-the-go to suit stone conditions without significantly altering seeding depth. In this case, a side banding configuration is typically best to minimise the impact of shallow operating depth on seed/fertiliser separation.

Disc seeders:

i) Heavy duty technology,
ii) Reduced down pressure, and
iii) Reduced operating speed (5-6km/h).

4 Managing marginal moisture in sandy soils

Sandy soils can dry out quickly and this can significantly impact germination. Seeding into a drying soil profile should aim to:

i) Seek and delve moisture from depth using low rake angle openers to enable seed placement into moisture while maintaining an optimum depth of soil cover. Low speed should be used to minimise soil throw and furrow moisture loss. Compact seed banding systems are best able to reduce moisture dilution in the seed zone from surface soil backfill.
ii) Where moisture is sufficient at the desired seeding depth, aim to place seeds in contact with undisturbed soil, such as at the bottom of the furrow, or on a side ledge with a side banding or suitable paired row attachment.
iii) Promote moisture migration to the seed and moisture holding capacity in the seed zone through sufficient furrow consolidation.

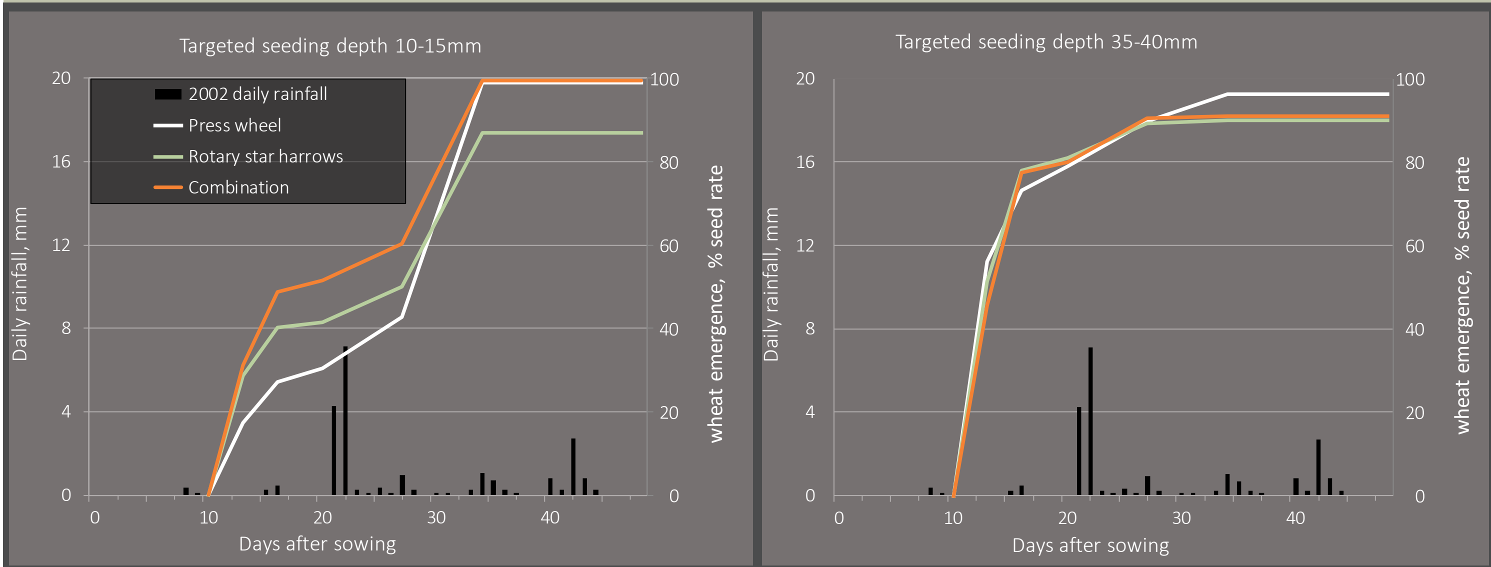

Figure 2: Effect of covering devices on wheat crop emergence under shallow seeding (left) and deeper seeding (right)

Figure 3: Effect of seeding systems on wheat crop establishment (percent seed rate) at 28 days after sowing, 2015 on a non-wetting Moorlands (SA) site.

iv) Conserve furrow moisture by adding dry soil mulch and keeping standing residue.

The dry soil or dust mulch technique using light star harrows operating behind press wheels was successfully demonstrated in a trial at Waikerie in 2003 (Figure 2). In shallow sowing (10-15 mm) the combination of press wheels and harrows significantly improved the rate of wheat establishment, however the same technique did not provide any benefit under deeper sowing (35-40mm) due to sufficient moisture buffer at that depth. A dry soil mulch effect may be obtained using snake chains following press wheels.

5 Managing furrow slumping in sands

Sands may display some apparent cohesion when wet, which can disappear upon drying due to the low clay content, leaving furrows at risk of collapse and soil particles subject to wind forces, leading to sand blast damage of young seedlings. Furrow collapse increases the depth through which seeds need to emerge, potentially impairing seedling emergence.

To maintain furrow stability in dry sands, the wall angle to the horizontal should not exceed 30 to 35 degrees, often matching the natural angle of repose. This can be achived by using ≥110mm broad wedge press wheel tyres to help create more stable water harvesting furrows. Tyre shapes able to press over the shoulders of the furrow may further increase furrow stability. Press wheel furrows directed across prevailing winds can shelter emerging seedling against sand blast damage.

6 Dealing with non-wetting sands

Gradual and localised wetting patterns in non-wetting sands lead to slow and patchy seedling emergence, staggered over time, sometimes continuing up to three to four months post-seeding. Wheat crop establishment into poorly wetted water-repellent sands showed interesting responses to seeding system technology at Moorlands in 2015 where the site received poor follow-up rainfall after seeding (10mm in six events until 28 days after sowing), shown in Figure 3. All seeding systems placed seeds below the centre of press-wheel furrows.

Under these conditions, the 'Mallee standard' double shoot knife point furrow opener established wheat at 77 percent emergence. Crop establishment significantly worsened under single shoot systems (35-58 percent emergence), due to fertiliser toxicity, especially with low soil disturbance disc systems. The best treatment, reaching over 90 percent emergence, was obtained by adding a shallow operating scooping share to clear away the top 3-4cm of soil into the inter-row zone and assist with placing seeds into moist soil.

This scoop design used as a proof-of-concept required low operating speed (5km/h) to avoid ridging. Paddock-ready 'scoop' solutions would need testing but could include concepts based on modified front coulters or knife points to emphasise an effective surface soil clearing at common operating speeds.

Paddock experiences suggest side and paired row banding systems, where water harvesting is emphasized towards the centre of the furrow, can be a disadvantage in water repellent soils where seed placement onto undisturbed soil moisture is typically not applicable, and the wetting of the seed zone is significantly impaired or delayed resulting in poor and uneven crop establishment. This limitation can apply both when sowing into poorly wetted sands, or dry-sowing into non-wetting sands. To improve crop germination in water repellent sands where seeds cannot be placed onto undisturbed moisture, the seed zone should aim to coincide below the centre of a water harvesting press-wheel furrow.

7 Shallow sowing

Shallower seeding is required for small seeded crops like canola and crop establishment is typically riskier unless good moisture is expected until emergence. Uniform and optimum crop densities are the key to maximising early weed competition and improve grain yield potential.

Research shows that seeding depth has a rapid negative effect of canola crop emergence, with 30 to 60 percent reduction in seedling emergence at 5 cm relative to 2.5cm depth. This effect is more pronounced with smaller seed size, such as with thousand-seed-weight below 3 to 3.2 grams. Grading canola seeds above 2mm is useful to minimise sensitivity to deeper seeding, which is a constant risk across sandy paddocks unless using contour following seeding system technology.

TABLE 1: SEEDER SETUP GUIDE FOR THE MALLEE

These general guidelines focus on ways to improve crop establishment across specific constraints, and should be interpreted with local agronomist advice for the specifics of each farm situation

SEEDER OPTIONS		Stony soils	Non-wetting gutless sands	Rhizoctonia pressure	Marginal moisture	High residue	Pre-emergence herbicide (IBS)	Notes
SEEDER OPERATION	Deep-till sowing	××	✓ If furrow backfill is not from surface soil	✓✓	✓ For moisture delving	o	o	For sub-seed disturbance, moisture seeking. Note: tillage depth limited to suit seed row spacing
	High speed sowing (TINES)	××	✓	✓ if not compromising seed placement	✓ If seeds placed into moisture with enough soil cover	×	✓	High speed tine sowing best with controlled soil throw not affecting adjacent seed rows (unless harrows are used)
	High speed sowing (DISCS)	××	✓ If improved clearing of top soil	✓ If not compromising seed placement	✓ If seeds placed into moisture	✓ If hair-pinning not an issue	✓✓ To improve incorporation	Maximum speed to suit paddock conditions and seeder technology
	Inter-row sowing	✓	××	✓✓ Preferred except in non-wetting soils	✓✓	✓✓	✓✓	RTK required with good seeder tracking capability and straight stubble rows
	On-row or near-row sowing	✓	✓✓	✓ **If non-wetting soils, fungicide recommended**	✓	××	× Higher risk for crop damage (esp. discs)	
FURROW OPENER	Narrow point	× For paddock roughness	✓✓	✓✓	✓ Low rake angle if seeking moisture delving	✓ If good residue management	✓✓	Tine seeders remain the mainstream technology in the Mallee
	Single disc	✓✓	××	×	✓✓ For moisture conservation	✓✓	× Unless with residue managers	Best practice paddock management and optimum disc seeder setup improves the potential of disc seeders
	Triple disc	✓✓	✓ Esp. with higher disturbance	✓✓ Esp. with fungicides	✓ Best if low disturbance	✓✓	✓ With higher disturbance	
SEED PLACEMENT	Centre row banding	✓✓	✓✓ Esp. below press wheel furrow	✓✓ Esp. with sub-seed disturbance	✓ If seeds are placed into moisture	✓✓ Esp. if inter-row sowing	✓✓	Easiest to match with low soil disturbance and water harvesting furrows
	Paired row or band seeding	✓ If extra disturbance is minimised	✓ With seeds placed at tillage depth	✓ With fungicide rhizoctonia management	✓✓ With seeds placed on undisturbed soil	✓ Clumping reduced if good residue management	✓✓	Improved soil/seed contact on undisturbed soil base
	Side banding	✓ If tillage depth is minimised	× Unless seeds are secured into moisture	✓ With fungicide rhizoctonia management	✓✓ With seeds placed on undisturbed soil	✓ Clumping reduced if good residue management	✓ Safest with compact systems	Improved soil/seed contact on undisturbed side ledge
FERTILISER PLACEMENT	With seeds	o	××	✓✓ Zinc and P nutrition near the seed recommended	××	o	o	Note: Increased fertiliser toxicity risks in low moisture environment and under low SBU
	Deep or split banded	✓ If tillage depth is minimised	✓✓	✓✓ Adequate N nutrition recommended	✓✓	o	o	Deep banding often requires deep-tilled furrows
FURROW CLOSING	Press wheels	✓ If hard rubber tyres	✓✓ Esp. if very wide tyre and wetting agent	✓✓ Helping seedling vigour	✓✓	✓✓	✓✓	Soil to seed contact and water harvesting furrow benefits
	Rotary harrows	× Unless suitable design	××	×	✓ Following press wheels	✓ For spreading clumps	× Unless safe to do so	Equalising soil throw and residue clumps
	Seed pressing & loose cover	✓ Subject to durability	✓ If seeds placed into moisture	✓ If seeds placed into moisture	✓✓	o	✓ If low risk of row contamination	Insulation of furrow moisture under loose soil cover. This option is preferred for compaction sensitive, crusting soils, and epigeal seedling emergence (lupins, canola)

Key: ×× not recommended at all; × avoid if possible; ✓ possible under conditions; ✓✓recommended; o no issue either way

Press-wheel furrow pressures should be minimised when sowing canola in heavier loams and if possible seed pressing with 2-3 cm of loose soil cover is preferable over a top-down furrow consolidation with press wheels.

8 Handling residue at seeding

Shallow sowing into residue with the use of pre-emergence herbicides increases the risks of crop establishment losses from seed to residue contact, especially in the header trail areas where chaff concentration is most significant. Residue clumps over the seed rows can also contribute to significant canola establishment losses.

Table 2: Approximate safe rates of Nitrogen applied as urea, DAP or MAP with the seed for cereal grains under optimum soil moisture conditions. Source GRDC Fertiliser Toxicity Fact Sheet.

Safe N rate (kg/ha)	Seed Spread 25mm (1")			Seed Spread 50mm (2")		
Row Spacing	180mm (7")	229mm (9")	305mm (12")	180mm (7")	229mm (9")	305mm (12")
Soil texture / SBU	14%	11%	8%	29%	22%	17%
Light soil (e.g. sandy loam)	20	15	11	40	30	22
Medium-Heavy soil (e.g. loam to clay)	25	20	15	50	40	30

With disc systems, residue hair-pinning must be controlled by:

i) Uniformly spreading residue at harvest,
ii) Maximising the proportion of standing residue,
iii) Accurate inter-row sowing into dry residue conditions and,
iv) Using residue managers where needed.

With tine systems, the extent of residue clumping must be minimised by:

v) Using high capacity tine designs within large inter-tine clearance layouts,
vi) Operating in short and uniformly spread dry residue and,
vii) Accurately inter-row sow, at best.

See also Farmtalk #19 (Jan 2006) for further details on improving residue handling capacity with tine seeders. The practice of sowing canola at double row spacing (neutralising every other row unit) can best facilitate shallow sowing in in heavy residue conditions.

9 Seed and fertiliser separation

Wider row spacing commonly used in Mallee no-till seeding systems result in more fertiliser being placed in the seeding row, increasing the risk of damage to emerging seedlings.

As a general rule, the order of sensitivity to fertiliser toxicity among major grain crops is:

Canola > lentil > wheat > peas > barley > oats

Fertilisers are salts and can affect the ability of the nearby seeds to absorb water by osmosis. High solubility, ammonium-based fertilisers have greater potential to release free ammonia under alkaline soil conditions and cause ammonia toxicity in seed. Urea and high analysis fertilisers used in Mallee environments can easily cause seedling damage on dry sandy soils.

Care must be taken to separate seed and fertiliser, especially with high nitrogen rates and wide row spacing. To avoid increased fertiliser concentration in wide-row systems, the safe rate of in furrow fertiliser decreases as row spacing increases and seed spread reduces (Table 2).

Trials have shown that seeding systems that have a high SBU minimise fertiliser toxicity risk. The greater the scatter of seed and fertiliser in the row the more fertiliser that can be safely applied with the seed. Higher SBU can be achieved through narrowing row spacing, and the use of ribbon or paired row seeding technology.

Soil conditions that tend to stress germinating seeds increase the risk of fertiliser damage. If the soils are dry, the rates should be at least halved from those in Table 1, though on dry sandy soils, including non-wetting soils, it is safest practice to have full separation between seed and fertiliser.

This can be achieved by splitting the seed and fertiliser through deep or side banding. For urea, 3.5 cm minimum vertical separation is required when banding fertiliser below the seed or 2.5 cm vertical and 2.5 cm lateral separation when side banding systems are used.

Canola trials in the Mallee have consistently shown effective separation of seed and basal fertiliser in moist environments can maximise seed germination rate, which is an important component of lifting canola emergence efficiency and minimise seeding rates of high cost hybrid seeds (Figure 4).

10 Herbicide toxicity

Tine seeders are generally safe with pre-emergence herbicides incorporated by sowing, provided the following guidelines are followed:

i) Control operating speed to ensure no soil throw reaches onto adjacent furrows
ii) Ensure seeds are placed at sufficient depth and covered with clean backfill
iii) Create stable furrows to limit risks of herbicide contaminated soils backfilling over time.
iv) Control of soil throw to within the inter-row zone is particularly important with water harvesting furrows which can also harvest soluble herbicides.

Care must be taken with disc seeders as many herbicides are not registered or have limited registration for use with disc seeding systems. However, trials have shown triple disc seeders provide similar crop safety to a standard knife-point press wheel system with pre-emergence herbicides when the front coulter blades generate sufficient soil throw. Of the herbicides examined, Sakura® caused little or no damage to wheat and provided 90 percent control of ryegrass, potentially making it the most suitable pre-emergence herbicide for use with low soil disturbance disc seeders.
In contrast, trifluralin significantly reduced wheat emergence with single discs but not with higher soil disturbance triple discs. Inclusion of residue managers fitted ahead of the single disc openers significantly reduced the risk of herbicide damage from trifluralin and Boxer Gold®.

The residue managers were set to operate as row cleaners and remove crop residue and surface soil from a 3-4 cm wide band in front of the discs, which resulted in partial removal of herbicide from the crop furrow and improved crop safety. Increasing the sowing depth of single discs by 1-2 cm was also shown to improve crop safety, most likely due to an increase in herbicide displacement by soil disturbance.

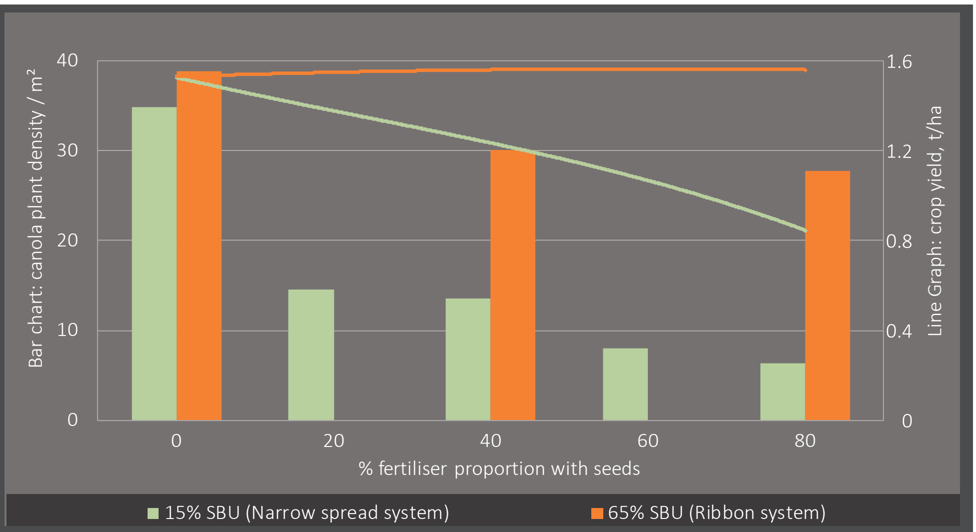

Figure 4: Canola establishment and yield for 65% and 15% SBU tine seeding systems influenced by fertiliser quantity applied with seeds (note: the balance of fertiliser was deep banded 3-4 cm below the seeds, 100% fertiliser rate/ha = 42N +17P) in the SA Mallee in 2000.

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MORE INFORMATION A full list of research cited in this Farm Talk is available at www.msfp.org.au

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Notes :