Successful sowing into stubble calls for adequate preparation

Key points

While many decisions regarding stubble retention are made before harvest (stubble height) or during fallow (mulching, incorporation, burning), setting up sowing equipment correctly is vital to ensuring sowing goes as smoothly as possible.

Inter-row sowing using 2cm RTK systems with auto-steer helps improve handling of heavy stubble loads.

Tined seeders are cost effective and offer improved disease control and seedling vigour through greater soil disturbance, but can be less efficient under higher stubble loads.

Disc seeders can cope with higher stubble loads and lessen soil disturbance, but may lose efficiency when soils are wet or compacted.

Retaining stubble in cropping systems can have multiple benefits including: increased soil moisture retention, reduced wind erosion and run-off, lower evaporation and higher infiltration rates.

However, stubble-retained systems can also present challenges. High stubble loads can increase the risk of blockages at sowing, reduce the efficacy of pre-emergent weed control, increase the impacts of allelopathy on subsequent crop emergence, and present mechanical issues.

The challenges associated with sowing into retained stubbles are also influenced by the previous crop. Canola and pulse stubbles are easier to sow into compared with the heavier loads derived from wheat and barley. During the early stages of adopting a stubble retention system canola offers a relatively easy-to-manage crop option. Gaining experience with canola stubble can help refine the management practices needed to manage the heavier stubble loads associated with cereals.

The rate at which various stubbles break down can impact stubble management after harvest (e.g. standing, incorporated, mulched stubbles all have different rates of breakdown etc). Adequate summer rainfall is also required to encourage stubble breakdown leading up to sowing.

Managing the challenges of sowing into retained stubble

Physical impediments

Equipment blockages during sowing present a major constraint in no-till stubble-retained (NTSR) systems and are one of the most-commonly cited reasons growers do not retain stubble.

Sowing machinery efficiency can decrease when stubble loads are 3t/ha or more. To help avoid reduced efficiency, ensure sowing equipment is set up correctly before sowing into heavy stubbles.

Wet soils and poor stubble breakdown can also exacerbate blockages at sowing.

Allelopathy

Allelopathy is the suppression of growth of a plant caused by compounds released by nearby plants or soil bacteria. Allelopathic effects are most often observed as the poor establishment of canola sown into wheat stubble. This is due to chemicals in the decomposing wheat stubble reducing nutrient availability to the sown crop. Sowing between the rows of the previous crop (inter-row sowing) can reduce the allelopathic interaction between the previous crop's stubble and the newly-sown crop.

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Inter-row sowing

Inter-row sowing can improve the efficiency of sowing into heavier stubble loads by improving the trash flow in the sowing row and minimising allelopathic impacts.

A 2cm RTK system with GPS auto-steer will provide the most accurate seed placement while holding a straight line. While sub-metre auto-steer (10–30cm) provides some benefits of GPS technology, the ability to maintain straight sowing lines is still compromised and subsequently the ability to sow between the previous crop rows is limited.

Guidelines for row spacing

Wider rows are easier to set up for inter-row sowing, however, GRDC-funded research carried out by Riverine Plains Inc as part of the *Improved Water-use Efficiency (WUE) in No-Till Cropping and Stubble Retention Systems in Spatially and Temporally Variable Conditions in the Riverine Plains* project demonstrated that at two sites (Coreen, New South Wales and Bungeet, Victoria), wheat sown on wider rows (>30cm) incurred a yield penalty due to later canopy closure and decreased dry matter (DM) production. The same trial showed there was little effect of row spacings on canola yield (Tables 1 and 2).

Further research from this project, presented in the publication *Between the Rows* also showed that narrow row spacings were found to yield considerably higher, produce more tillers and use more nitrogen than wider rows.

Similar results were observed in row spacing research carried out by Southern Farming Systems (SFS) for the high-rainfall region of Victoria.

TABLE 1 Influence of row spacing on the yield of different crops in the rotation at Coreen, NSW (2009–12)

Row spacing (cm)	First wheat	Second wheat	Canola
	2009, 2010 & 2012	2010 & 2011	2009, 2011 & 2012
	Average (t/ha)		
22.5	4.01	4.12	2.03
30.0	3.82	4.00	1.82
37.5	3.63	3.87	1.91
Mean	**3.82**	**4.00**	**1.92**
LSD	0.20	0.15	0.40
P value	0.016	0.034	0.438

Source: *Between the Rows*, Riverine Plains Inc, 2015

TABLE 2 Influence of row spacing on the yield of different crops in the rotation — Bungeet, Victoria (2009–12)

Row spacing (cm)	First wheat	Second wheat	Canola
	2010 & 2011	2009, 2011 & 2012	2012
	Yield (t/ha)		
22.5	4.74	3.84	2.67
30.0	4.25	3.58	2.35
37.5	4.13	3.38	2.75
Mean	**4.37**	**3.60**	**2.59**
LSD	0.09	0.36	* only 1 rep
P value	0.002	0.059	

Source: *Between the Rows*, Riverine Plains Inc, 2015

Early sowing supports wider row spacings

The key to making wider row spacings pay in the Riverine Plains region is to sow earlier than the traditional sowing window of mid-May to early June.

Rules to follow for inter-row sowing

- The base station for a particular paddock must remain at the same location every year.
- Ensure your auto steer can store and recall an A:B line for a particular paddock.
- Ensure your auto steer has a 'nudge' feature in order to move the required distance to go inter-row (e.g. nudge over 150mm in year two if you are on 300mm spacing). Off-set hinges can be used in the absence of nudging the path of the tractor.
- Keep the same row spacing year-in year-out.
- Sow in the same direction each year for each run, if possible, (sowing rigs will crab, but hopefully crab in the same pattern as the previous year).
- Use independent depth control for even seedling depth.
- Ensure a frame clearance of at least 500mm and clearance between bars of at least 650mm.
- Use bolted frame components for easier adjustments of planter units when needed.
- Use a coulter to cut through stubble and reduce soil disturbance: fluted coulters are ideal.

When buying new machinery or modifying existing equipment, it is important to consider equipment adjustments:

- A longer drawbar delivers a higher level of leverage and better tracking. A rule of thumb is to have a drawbar length that is half the implement width.
- Castor wheels tend to be less stable compared with fixed wheels, as they lack lateral stability.
- A pull-behind seed box (seed box behind seeder) will be slightly better for accurate tracking than when pulled between.
- Using a tram-track system in conjunction with a residue manager will reduce the amount of residue building up on tines by pushing surface stubble away.

Source: *Managing Stubble*, GRDC, 2012: https://grdc.com.au/Resources/Publications/2012/05/Managing-Stubble

GRDC-funded row-spacing research by Riverine Plains Inc showed that when wheat was sown at Barooga during mid-April 2014, there was no yield penalty associated with wide row spacings (measured up to 37.5cm). While individual cultivars varied in their yields during this trial, there was no interaction with row spacings. This meant the effect of altering row spacing was the same for all cultivars measured (Table 3).

Tines vs discs

While there are many configurations of sowing implements on the market, it can be difficult to decide whether a tine or disc system will provide better seed placement at the required depth.

Tine systems

Tined sowing equipment can be cost effective and has also been found to suit a large range of soil types. However, the effective use of a tine system when sowing into stubble relies on clean stubble flow, as there is no cutting mechanism on the actual tines.

A tine system can have more difficulty handling higher stubble loads compared with discs due to the higher risk of blockages caused by stubble being caught around tines.

If stubbles are grazed during summer, stock can often trample and flatten the stubble. This can increase the risk of blockages in tined systems, especially where stubble is long and may wrap around tines.

Minimum till systems do not adequately incorporate lime to depth, however the soil disturbance created by the tine action can help mix the soil layers, aiding in lime and/or gypsum incorporation. A tine system will generally not perform as well as a disc system on stony soils.

Consider the following recommendations, from the GRDC *Stubble Management* fact sheet, when setting up tined sowing equipment for stubble-retained systems:

- Maximise the spacing between the tines. A seeder bar should generally have at least five ranks spaced at least 50cm apart. This allows for space to clear material if it builds up. The spacing between tines may increase towards the rear of the machine where stubble build-up is generally greater.
- Match the spacing between the tines to stubble length. Spacing between tines should be about twice the stubble length. If the inter-tine clearance is small, stubble will need to be cut short.
- Using press wheels improves seed-soil contact, improving germination rates and aiding water harvesting in the furrows.
- Arrange tines to minimise the chance of clumping of stubble in front of following tines.
- Locating press wheels too close to the back row of tines can also cause stubble build-up.
- Position wheels to maximise stubble flow, with nearby tines located in front of the wheel.
- Plan to sow into heavy stubbles when dry (if possible!), as blockages may be more common when stubbles get wetter, including falling dew.
- Use lower-reaching narrow points (such as knife points) and shallow tillage depths to maximise clearance.
- Slow operating speeds reduce the risk of stubble clumping and blockages, but specific speeds will vary between equipment and management practices (e.g. row width).
- Fitting poly or exhaust pipe (40–50mm diameter) to tine shanks reduces stubble build-up.

TABLE 3 Influence of row spacing and cultivar on yield and grain quality for a trial sown at Barooga, NSW, on 15 April 2014.

Row spacing (cm)	Cultivar	Yield and grain quality			
		Yield (t/ha)	Protein (%)	Screenings (%)	Test weight (kg/hl)
22.5		3.85	11.8	2.8	77.5
30.0		3.98	11.9	2.7	78.9
37.5		3.78	11.8	2.6	79.2
Mean		**3.87**	**11.9**	**2.7**	**78.5**
LSD (5%)		0.20	0.7	0.2	1.8
P value		0.107	0.967	0.253	0.133
	Bolac⌽	4.14	11.2	3.4	79.9
	Eaglehawk⌽	3.28	12.4	3.2	78.5
	Lancer⌽	4.02	12.0	2.2	80.2
	Wedgetail⌽	4.05	11.9	2.0	75.5
	LSD (5%)	0.17	0.6	0.4	2.0
	P value	<0.001	0.004	<0.001	0.000
Interaction		0.282	0.967	0.575	0.420

Source: *Between the Rows*, Riverine Plains Inc, 2015, p37.

Disc systems

Disc systems are generally regarded as being better able to handle taller standing stubble compared with a tine system. Because of their ability to handle higher stubble loads, a disc seeder would work well in systems that retain stubble, mulch, incorporate and graze. Because there is less resistance, disc systems require less horsepower and fuel and can be operated at higher speeds when compared with tines (optimal speed will depend on individual seeders). Furthermore, as soil disturbance is limited, weed germination under a disc sowing system may be less.

Disced sowing equipment can better handle stony soils, but is less efficient where soils are wet or compacted.

When compared with a tine system, disc equipment is generally more expensive to purchase, but may operate at a lower cost if set up appropriately.

Consider the following recommendations, from the GRDC *Stubble Management* fact sheet, when setting up disced sowing equipment for stubble-retained systems:

- Use residue avoidance techniques, such as inter-row sowing, into tall standing stubble and consider row cleaners/residue managers.
- Maximise residue cutting capacity using a sharp disc opener set at optimum depth and operating in dry stubble and firm soil conditions.
- If sowing into wet stubble and soft soil, disc openers can push residue into the furrow, rather than being cut (hair pinning). This reduces seed–soil contact and causes patchy establishment.
- Inter-row sowing with +/- 2cm RTK accuracy guidance and auto steer can increase the volume of stubble handled and improve establishment.

Local conditions — discs vs tines?

Research from the Riverine Plains Inc GRDC-funded *WUE Project*, found that although different drill openers created differences at establishment, there was little impact on crop growth and resulting yield for first wheat (first wheat in the rotation) and second wheat (wheat on wheat) (Tables 4 and 5). This research also found that across four data sets, there was a significant yield advantage in canola when a disc opener was used (Table 6). This may have been due to the preciseness of seed placement achieved by the disc openers and/or a reduction of allelopathic influences due to the reduced soil and stubble disturbance gained from the disc system.

TABLE 4 Influence of drill opener in the first wheat rotation position on plant establishment at the three-leaf stage (GS13), tiller production (start of stem elongation — GS31), heads per metre square and yield across five trials (2009–12)

Drill opener	Canopy composition			Yield (t/ha)
	Plants/m²	Tillers/m²	Heads/m²	
Disc	160	430	329	4.03
Tine	155	385	316	4.06
Mean	**157**	**407**	**322**	**4.05**
LSD (5%)	13	55	16	0.28
P value	0.34	0.09	0.08	0.80

Source: *Between the Rows*, Riverine Plains Inc, 2015

TABLE 5 Influence of drill opener in the second wheat rotation position on plant establishment at the three-leaf stage (GS13), tiller production (start of stem elongation — GS31), heads per metre square and yield across five trials (2009–12)

Drill opener	Canopy composition			Yield (t/ha)
	Plants/m²	Tillers/m²	Heads/m²	
Disc	147	409	305	3.81
Tine	140	370	282	3.71
Mean	**144**	**389**	**293**	**3.76**
LSD (5%)	8	36	22	0.20
P value	0.05	0.04	0.04	0.26

Source: *Between the Rows*, Riverine Plains Inc, 2015

TABLE 6 Influence of drill opener on the establishment of canola at the three-leaf stage and yield across four trials

Drill opener	Plants/m²	Yield (t/ha)
Disc	111	2.13
Tine	126	2.05
Mean	**119**	**2.09**
LSD (5%)	39	0.06
P value	0.28	0.03

Source: *Between the Rows*, Riverine Plains Inc, 2015

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GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

RiverinePlains

Riverine Plains Inc.

PO Box 214 Mulwala NSW 2647
T. (03) 5744 1713
E. info@riverineplains.org.au
W. riverineplains.org.au

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