Inter-row sowing

Seeding between rows, better known as inter-row sowing has been widely adopted by growers in the low to mid rainfall zones of the Victorian Mallee and Wimmera.

The practice, which sees crops sown between the previous year’s stubble rows, is compatible with stubble retention as it minimises trash flow issues at seeding.

Additionally, crop emergence is improved in the rows kept stubble free while plant residue in the inter-row will help suppress weeds and mulch the soil.

Increased stubble retention, which is assisted by inter-row sowing, improves water infiltration and conservation and helps to reduce soil erosion.

Efficiency gains also result from inter-row sowing through precise seed placement with less herbicide throw into crop rows, reduced tractor driver fatigue and a number of other agronomic benefits (McCallum, 2008) such as enhanced harvestability of pulse crops (stubble acts as a trellis for lentils and chickpeas) and lower take-all and crown rot disease pressure.

**Successful inter-row sowing**

Repeatable straight line accuracy is important to ensure the seeding row remains within the intended stubble inter-row. To achieve this, a real time kinematic (RTK) auto-steer tractor guidance system is typically used, which offers ± 2cm accuracy.

Less accurate guidance systems (such as sub-foot guidance which delivers accuracy from ±10 to ±30cm) are not generally suitable for inter-row sowing in winter crop environments.

In practice, the success of inter-row seeding varies markedly according to the tractor guidance accuracy and the implement tracking stability. Success rates are estimated at:

- 90% for ±2 cm RTK system using own base station
- 70% for sub-foot guidance (±10 to ±30 cm)
- 50% by eye using permanent wheel tracks

Consequently, successful inter-row sowing requires a strategy for uniform machinery set up, correct RTK guidance with a residue management plan and a system that provides a means to retain standing stubble and sow with the same row spacing in the same direction each year (Gooden, 2007).
Generally, inter-row sowing is easier to implement at wider row spacings (greater than 22cm, or 9 inch) and is generally unsuitable for systems with row spacing less than this (GRDC, 2011).

This is being further investigated through the stubble initiative with a fact sheet scheduled for publication in March 2016.

**Getting good guidance**

An accurate tractor guidance system (RTK) with a reliable guidance signal from season to season (constant base-station location), a stored paddock AB line data, and a suitable nudging factor or implement hitch offset are critical to inter-row sowing success.

In the best case scenario, tractor guidance is enough to achieve suitable implement guidance when implement tracking is stable. However, in practice, implement tracking is variable and influenced by a number of seeder design and terrain factors.

In some instances implement skew angle makes the implement go off-track and generates difference in sown row spacings across the bar, making it harder to inter-row sowing in the following year.

To help manage tracking issues, similar sowing patterns should be followed each year. However, when implement tracking is not suitable, additional implement guidance technology is required.

Passive implement guidance such as the tractor’s auto steering and sophisticated software that can guide the tractor on an alternative track, can be used to keep the implement on the intended guidance path.

Active implement guidance is when implements are actively steered to remain on the intended guidance path, in addition to, and independently of, tractor guidance. Examples include steerable tractor and implement hitches, and steerable implement wheel or disc kits.

Sensors used to detect implement position include stubble row tracking or implement differential guidance positioning system (DGPS) position data.

Many implement design factors influencing tracking. Key requirements include constant operating depth across the seeder bar and sufficient weight on frame wheels which act to minimise implement skew angle.

Longer A-frames are important to make these wheels more effective.

Seeder residue handling capacity remains important when off-tracking.

A generous tyne layout (under-frame clearance of at least 500mm) is recommended to avoid stubble blockages and residue managers fitted to disc seeders help to reduce residue hair-pinning.

**Implications of stubble load for inter-row sowing**

Challenges at seeding, and with crop performance, can occur when the stubble load is greater than 3-4t/ha of dry matter (GRDC, 2011).

Approximately 100g/m² of dry stubble is equivalent to 1t/ha of crop residue.

Wheat stubble dry matter proportion can be 1.3 to 2.8 times the grain yield, although this ratio varies with the season, time of sowing, soil type and variety.

To determine stubble dry matter use the following calculation:

\[
\text{grain yield (t/ha)} \times 1.5 = \text{stubble dry matter (t/ha)}
\]

**Beating blockages**

Blockages of sowing implements at seeding is perceived as one of the major impediments to inter-row sowing.

Modification to the tyne profile and layout can reduce stubble clumping and blockages. Bar clearance and tyne layout have a stronger influence on the machine’s ability to cope with heavy stubble loads.

Inter-tyne spacing of 55-60cm is adequate in 3.5 to 4.5t/ha wheat stubble cut at 35-40cm.

For a taller stubble of 45-55cm, inter-tyne spacings need to increase to 80cm for standing stubble.

However, stubble management for an inter-row sowing system will vary according to seeder type (Table 1)

There are a number of other strategies that can be adopted to manage crop stubbles. These are listed in the GRDC fact sheet ‘Strategies to manage winter crop stubbles without reaching for the matches’ (GRDC, 2011).

<table>
<thead>
<tr>
<th>Table 1. Guidelines for stubble height</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tyne seeders</strong></td>
</tr>
<tr>
<td><strong>Maximum straw length</strong></td>
</tr>
<tr>
<td>No more than half the shortest clearance between seeding tyne assemblies and no more than two-thirds of the vertical tyne clearance in the work position (from ground to the lowest shank obstruction under the tool bar).</td>
</tr>
<tr>
<td><strong>Paddock operation</strong></td>
</tr>
<tr>
<td>Best in dry stubble conditions following the header direction and with lower travel speeds.</td>
</tr>
<tr>
<td><strong>Paddock operation opener design</strong></td>
</tr>
<tr>
<td>Prefer straight tine shanks, close to vertical or slightly backward leaning, and with smooth, round interface.</td>
</tr>
</tbody>
</table>
Inter-row sowing and stubble retention in a high rainfall zone

Retention of large stubble loads in the high rainfall zone (HRZ) brings with it many and varied challenges.

Crop establishment, seeder blockages, herbicide efficacy, integrated weed management, disease carry over, nutrition management, pest harbours and harvest management techniques are all a focus of the GRDC-funded project 'Maintaining profitable farming systems in retained stubble (BWD00024)'.

Trial plot seeding equipment, by design, is often unsuited to stubble retained research. To overcome this SFS established on-farm trials using commercial seeders and machinery specifically setup for inter-row sowing systems.

In 2014 at Yalla-Y-Poora, in the western districts near Geelong, SFS established an on-farm demonstration that compared a range of stubble management strategies.

These included:
1. Stubble retained, 30cm (high)
2. Stubble retained, 15cm (low)
3. Stubble burnt
4. Stubble harvested high then incorporated
5. Stubble harvested low into windrows and baled

**Trial details**

**Aim:** to determine how stubble management influences the establishment, yield and dry matter production of a canola crop sown with a tyned seeder, and the impact on slug numbers.

**Location:** Yalla-Y-Poora, Southern Victoria HRZ

**Soil type:** brown clay loam

**Variety:** Thumper canola

**Sowing date:** 12 May 2014

**Results and Interpretation**

**Observations:**
- Incorporated stubble caused serious seeder blockages, standing stubble less so
- Inter-row sowing into 30cm stubble had no negative impact on establishment
- Canola sown into the burnt and 30cm retained standing stubble treatments displayed similar early vigour
- Slug control was similar regardless of product used
- Burnt and incorporated strips were less affected by slugs in the untreated strips
- Burnt stubble treatments yielded slightly more than other treatments

From the demonstration work there are some clear messages.

Inter-row sowing with tyned seeders is possible into 30cm retained stubble with RTK guidance, but agronomic management may need to be adjusted to suit this system. A Gason seeder used was on 250mm row spaces which is considered the minimum row space.

Slug control products used had no impact on slugs but slug damage occurred in the retained stubble and baled strips.

Final yields for retained 30cm standing stubble were lower than the stubble harvested at 30cm and burnt. Reasons for this were unclear (Table 1).

Growers should gain some confidence when adopting a retained stubble system from this demonstration.

**TAKE HOME MESSAGES:**

- Inter-row sowing is strongly dependent on access to accurate and reliable auto-steer guidance systems
- Implement steer systems improve inter-row seeder tracking and avoids crabbing into old furrows
- Wider row spaces reduce crop competition with weeds but can reduce yield potential in cereals. Conversely wider rows improve pesticide contact and inter-row sowing.
- Crop rotations play an important role in inter-row sowing establishment, weed, pest and disease control.
- Some disc seeders have better trash handling capabilities compared to tyned seeders and are better suited to narrower row spaces.
Table 1. SFS stubble management demonstration, Yalla Y Poora 2014

<table>
<thead>
<tr>
<th>Stubble treatment</th>
<th>Yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stubble harvested at full height and burnt</td>
<td>2.4</td>
</tr>
<tr>
<td>Stubble harvested at full height, incorporated (top downed) and then sown</td>
<td>2.2</td>
</tr>
<tr>
<td>Stubble harvested low and spread</td>
<td>2.3</td>
</tr>
<tr>
<td>Stubble harvested low and baled</td>
<td>2.3</td>
</tr>
<tr>
<td>Stubble harvested at full height, then direct drilled into standing stubble</td>
<td>2.2</td>
</tr>
<tr>
<td>Stubble harvested at full height and burnt</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Growers are reluctant to burn stubble for a range of reasons such as time taken, resources required, annual increases in restrictions, loss of ground cover, nutrients loss, erosion risks and air pollution.

The tyne and press wheel system is considered the least suited to inter-row seeding in tall stubble on row spaces less than 25cm. Adoption of inter-row sowing is practically achievable in the HRZ and practicing growers and advisors are improving the system continually to maintain profitability at the same level as traditional burn practices.

Discussion

While stubble retention provides recognised benefits there are also many problems related to retaining stubble and inter-row seeding, especially in the HRZ.

Inter-row sowing enables machinery to avoid stubble for ease of sowing and herbicide application but managing stubble loads greater than 4-5t/ha can be difficult.

Carryover stubble from previous years can also add to the amount of stubble to be sown through. Careful management (cutting height) of stubble is key to effective inter-row sowing in the following year.

Growers have been adjusting their systems to eliminate or minimise problems as they arise. A number of growers have been retaining stubble and inter-row sowing for many years and have experienced and overcome many of the major problems.

To help avoid blockages and poor plant establishment, accurate RTK guidance (+/-2cm) and auto-steer is important. Implement guidance, in some cases, will reduce crabbing into old furrows.

Sowing in the same direction on the same row spacing is also essential.

Disc seeders have increased trash handling capacity that improves inter-row sowing capabilities. They are more suited to narrower row spaces which have been shown to be advantageous in crops yielding higher than 3t/ha (Scott, Martin & Reithmuller et al).

Disc seeders also have traits that require unique agronomic management to maintain crop yields at profitability levels the same as traditional systems.

Mixed farming with integrated livestock and cropping can be beneficial or problematic for an inter-row sowing system.

Livestock can reduce the chaff portion of stubble on the ground by increasing rates of break down.

If the stubble is higher in nutrition value (eg. frosted crops) sheep will eat it readily and reduce the total biomass. If it is not nutritious (eg. high yielding crops) they will consume very little and their traffic will lay stubble over and increase problems with inter-row seeding.

In discussions with leading stubble retention practitioners from NSW, SFS has compiled a list of system based strategies for growers to reference when adopting a similar system. This list can be found on the stubble project website at: https://thestubbleproject.wordpress.com

Thanks go to Greg & Kirrily Condon, Michael Sinclair, Steve Day and Matt Dart for their contributions.

References


Ground cover TV, SFS seeder trial www.youtube.com/watch?v=Ue6x1fFp7aWs

SFS Meridian Ag seeder trial video interviews: www.youtube.com/watch?v=ffij45dwiUU; www.youtube.com/watch?v=K3MecWUC2ek; www.youtube.com/watch?v=a5BWmBfpbtU

This guideline was produced by Birchip Cropping Group Inc. (BCG) with assistance from Dr Jack Desbiolles (UniSA) and input from Southern Farming Systems (SFS), Irrigated Cropping Council (ICC) and the Victorian No Till Farmers Association (VNTFA) as part of GRDC project No. BWD00024, ‘Maintaining profitable farming systems with retained stubble in Victoria and Tasmania’.