Maintaining profitability in retained stubble systems on upper Eyre Peninsula

A joint EPARF and GRDC funded project.

Guideline 7: Sowing position and row spacing in cereal stubbles

Eyre Peninsula growers retain stubble to protect soils from wind erosion and increase soil organic matter and soil biology. Stubble retention systems have lower soil disturbance and retain higher levels of soil surface cover, which is especially important in this environment as livestock are still a major component of many farming systems[1]. With advances in global positioning system technology in recent years, growers now have the ability to accurately place seed relative to the previous stubble row.

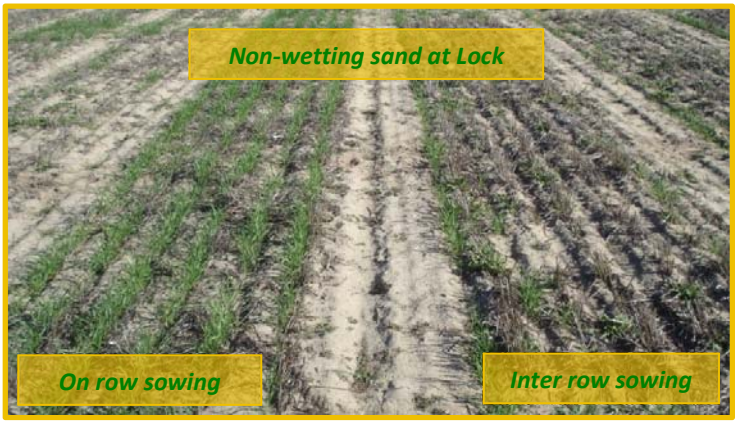
The best position of sowing in relation to the previous crop rows, either inter-row or on-row, will depend on soil type, disease inoculum levels, the ability of sowing equipment to precision sow, row spacing and stubble flow, and grass weed competition. In most farming systems inter-row sowing position will be the preferred option to improve stubble flow and speed of the sowing operation, however on-row sowing can improve grass weed competition and in non-wetting soil types may improve crop establishment.

This guideline presents the pros and cons of different sowing positions and describes situations when you might choose one over the other.

	Benefits	**Disadvantages**
Inter-row sowing	• Direct drill sowing in inter-rows with wider row spacing can increase trash flow and reduce seeder blockages. • Can reduce damage from soil and wind to emerging crops. • Can lower stubble borne disease inoculum by placing the seedling away from higher disease levels for many diseases such as crown rot, take-all, common root rot and root lesion nematodes[2] and generally Rhizoctonia disease inoculum level.	• Cost of investing in technology with auto steer and implement guidance systems to have repeatable accuracy to achieve sowing position accuracy along the length of the paddock. • Is more practical with wide rows but a yield penalty can occur with wider row spacings. So minimising row spacing with a workable stubble management system is important to maximise grain yield.
On-row sowing	• Has resulted in greater germination on non-wetting sands in drier sowing conditions. The old stubble row has a wicking effect, increasing soil moisture in the previous crop row. • More nutrients are available in the old crop row, especially after a low production season. • The ability of legume crops to use the old stubble rows as a trellis, grow higher off the ground and potentially improve harvestability[4].	• Increased technology cost to obtain the precision needed for on or near-row sowing. • May increase disease risk from stubble borne diseases by placing the seedling into higher disease inoculum situations. These diseases include crown rot, take-all, common root rot and root lesion nematodes[2]. • Increased risk of poor stubble flow and extra sowing blockages. • Increased risk of hair-pinning stubble which may reduce seed soil contact and potentially lower plant establishment. • Increased risk of poor seed placement and lower plant establishment, especially in small seeded crops like canola.

Sowing position effects on a red sandy loam

Consistently implementing inter-row or on-row sowing generally requires specialised equipment, although it can be implemented manually. The equipment to reliably and accurately implement precise seed placement along the entire length of the paddock, especially in variable terrain, usually involves a GPS tracking system with auto steer and repeatable accuracy to 2 cm.



Sowing position will depend on soil type. Field experiments on a red sandy loam soil at Minnipa Agricultural Centre (MAC) over three seasons (2014 -17 with a WWWBB rotation) with an average of 4.5 t/ha stubble loads, showed that seed row position had little impact on plant establishment and cereal crop production[5].

Sowing position effects on non-wetting sands

In 2015 at Lock on a non-wetting sand in drier sowing conditions, crop establishment increased with on-row sowing (Table 1). Research from other regions has shown stubble from the previous season has helped soil moisture infiltrate into non-wetting sands along the previous crop row, called the 'wicking effect', and into a position closer to the seed if on-row sowing[3, 6, 7]. In 2016 in wetter seasonal conditions at Lock seed placement did not impact crop establishment. Sowing on-row in sands or loam that did not express non-wetting characteristics, or had good soil moisture at sowing did not capture the same level of benefits[3].

Research in the Mallee showed sowing technology can affect crop factors that determine grain yield, including access to soil moisture, nutrition and disease impact. Field trials suggest crop performance in sandy soils improves under paired row sowing systems, and sowing in non-wetting sands can benefit from furrow sowing technology that clears the top water repellent layer away from the seed row and places the seed in moist soil[8].

Table 1 Plant and weed establishment at Lock on a non-wetting soil, sown 18 May 2015

2015 placement	Establishment (plants/m^2)	Early Brome grass between crop rows (plants/m^2)	Early Brome grass in crop row (plants/m^2)	Late Brome grass (plants/m^2)
On-row	112 a	5.9	2.8	5.0
Inter-row	45 b	12.8	1.2	6.4
LSD (P=0.05)	*30*	*6.9*	*1.5*	*ns*

Increased crop establishment from on-row sowing increased grass weed competition at Lock. Brome grass numbers shown in Table 1 both before and after in-crop spraying (although not statistically significant later) were lower with on-row sowing, and most of the late brome grass came up between the rows of the crop[6]. At Karoonda sowing crops on or very near last year's crop row reduced brome grass seed set by over 70% compared to inter-row sowing[3].

Weeds

Sowing on-row can increase crop emergence and competition and lower grass weed seed set. Brome grass densities were monitored at Karoonda in the SA Mallee on three occasions during the 2015 growing season[3]. Both plant density and seed density were higher following inter-row sowing compared with on-row sowing. This resulted in significantly more seeds following inter-row sowing (Table 2). On-row sowing reduced brome grass seed production by 72%[3]. A similar result was obtained at Lock in 2015 (Table 1)[6].

Table 2 2015 Karoonda brome grass plant density (plants/m^2) and total seed production (seeds/m^2) [3]

	Plant density (plants/m^2)	Seed density (seeds/m^2)
On-row	28 b	2022 b
Inter-row	105 a	7332 a

Disease

Disease inoculum research and surveys conducted in the Upper North and Mallee regions have shown disease inoculum levels for Rhizoctonia, crown rot, take-all, common root rot and root lesion nematodes are higher in the previous crop row compared to the inter-row[2,3]. For paddocks with medium to high disease risk levels, sowing a cereal between the old cereal rows is likely to reduce the risk of yield loss from these diseases. Rhizoctonia inoculum was higher with on-row compared to inter-row sowing but this did not carry through to an effect on rhizoctonia infection in the crop[3, 9].

Nutrition

Sowing near the previous crop row, into an area of higher residual fertiliser, especially after a drier season or with a dry start to a season, may reduce starter fertiliser requirements, while sowing away from residual fertiliser will delay crop access to the nutrition[10]. However there may be a higher potential for N immobilization sowing in the on-row position. In situations where higher rates of nitrogen fertiliser are drilled pre-sowing (greater than 50 kg/ha), then mid row banding of the fertiliser may be a benefit to crop establishment and N fertiliser recovery[11].

Row spacing

The adoption of stubble retained no-till farming systems resulted in a move from traditional 18 cm row spacing to wider row spacing for ease of stubble handling. As the yield of the crop increases, so does yield loss in wheat and barley by moving to wider row spacing. In crops less than 0.5 t/ha increasing row spacing has no effect on the yield of cereals. On average, expect an 8% decrease in yield for every 9 cm increase in row spacing from 9 cm to 54 cm. Increasing row spacing will also result in less crop competition for grass weeds, and slower crop canopy closure[10].

Research at Minnipa in 2015 and 2016 showed reducing row spacing to 18 cm from 30 cm increased grain yield of wheat by 0.5 t/ha or more in four trials with 2.7-3.3 t/ha crops, which is a slightly higher increase than suggested by the bulk of research. In 2016 late grass weed dry matter in 18 cm row spacing was 42% lower than in 30 cm row spacing, with a 44% reduction of barley grass weed seed set in the 18 cm row spacing[12].

Sowing the same plant density while increasing row spacing, may increase crop competition for moisture and nutrition within the crop rows. The concentration of fertiliser is higher in wider row spacing which may cause extra seedling toxicity or germination issues, especially in smaller seeded crops like canola[13]. Research in higher rainfall regions has shown benefits with mid–row banding nitrogen fertilisers at high rates[14].

Inter row sowing

The decision of width of row spacing within farming systems is a compromise between grain yield, stubble handling, speed of sowing and soil throw for effective use of pre-emergent herbicides and weed competition. Wider row spacing for inter-row sowing may result in lower yields, so try to minimise row spacing with a workable stubble management system, which may include reducing stubble loads by grazing of stubble dumps, slashing, chaining, burning or narrow windrow burning.

In most farming systems the inter-row sowing position will be the preferred option to improve stubble flow and speed of the sowing operation, however in non-wetting soil types on-row sowing may be a benefit for crop establishment and to also improve weed competition.

What sowing position do I select?	Sowing conditions	Soil type	Weeds	Diseases	Nutrition	Stubble management
Inter-row	Ideal sowing conditions with good soil moisture	Soil types other than water repellent	Low grass weed numbers	High stubble borne disease inoculum levels	High soil fertility	High stubble loads with poor trash flow (may be an issue in > 2.5t/ha yields depending on grazing levels and sowing system)
On-row	Dry sowing or drier sowing conditions	Water repellent soils	High grass weed numbers	Low stubble borne disease inoculum levels	Poor soil fertility, nutrition or drought in previous season	Lighter standing stubbles (0.5-2.5t/ha yields depending on grazing levels and sowing system at higher yields)

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