Spacing sowing rows

Wide rows enable stubble retention

- Wider row spacing was an "enabling" factor when farmers adopted stubble retained cropping systems, but in many regions it comes at a yield penalty.
- In all but low rainfall areas, yields of wheat and canola are reduced by widening row spaces; the wider the row space the greater the yield loss.
- Minimise row spacing, consistent with a working stubble management system, to minimise losses.
- Consider alternative methods of sowing into high stubble loads such as a disc seeder or reduction of trash by mulching, baling, grazing or burning before going to wider rows.
- However, faster sowing with less tractor horsepower is achieved with wider rows.
- Inter-row sowing avoids the problem of machinery blockages, but requires accurate GPS (2 cm) and a minimum of 30 cm spacing, and precludes grazing as a fallow option.
- Good agronomy has an economic benefit at all row spacing.

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How much space do you need?

The adoption of conservation farming in Australian cropping systems has been extensive over the last 20 years with economic benefits from reduced tillage and improved soil conditions. Wider row spacing has often been the "enabling " factor that has allowed farmers to adopt stubble retention. Prior to the advent of conservation farming, "7 inch" (18cm) tine spacing on seeders was the standard practice with wide points that gave maximum soil disturbance for weed control and quick crop emergence. The problem was that high stubble loads cause seeding equipment blockages on narrow row spacing, and crop emergence is hindered. Later research has shown that increasing row spacing reduces yield in many crops.

This guideline discusses the changes to row spacing and the effects this has on agronomic practices.

Why use wider rows?

Fewer machinery blockages at sowing with high stubble loads.

For many farmers interested in direct drilling crops the major hurdle has been blockages of sowing equipment. To overcome this without spending large amounts of capital changing over to different systems such as disc seeders, existing tined gear was adapted. In 2003 Mead and Quasrani (NSW DPI) came up with a long list of ways of adapting older sowing equipment to give increased trash flow and prevent blockages, but warned that increasing row space can have yield reductions. The major changes were the use of narrow points, wider spaces between tines and between ranks of tines.

As well as blocked sowing gear causing stoppages, stubble was often clumped after sowing that prevented the even germination of crops, especially canola. Wider rows can help spread the residue so that there is less clumping.

Lower machinery costs, faster sowing

The move to no-till has allowed faster sowing. Sowing equipment can be wider and can be operated at higher speeds. Agronomists stress the importance of sowing different varieties within their specific sowing windows to achieve maximum yield potential and to minimize drought, heat and frost risk at the critical flowering period. No till has greatly improved the timeliness of sowing operations, but it has also created other issues that need attention. At higher sowing speed, soil throw is increased causing herbicide toxicity to crops and seed coverage being either too shallow or too deep . Alternatively when row spacing is increased fewer row units are required on the sowing bar and the lower draught requirement of tractors means lower maintenance and fuel costs.

Options for inter-row sowing and weed control

Wider rows allow crops to be sown in the inter-row of last year's crop residues. Seeders with a higher frame to clear the crop mean that contact with standing stubble can be avoided, and blockages minimised. Ground cover is not compromised during the fallow, and recent research has shown that standing stubbles will discourage aphids from attacking crops. Without the layer of mulch on the surface, habitat for pests such as Rutherglen bug, slaters, millipedes and earwigs is also reduced. Many farmers have been interested in using Controlled Traffic Farming (CTF) techniques with inter-row sowing, but accurate GPS guidance (2cm) and a minimum of 30cm row space is required for this type of operation. The wide row spaces give the opportunity to use tillage or a shielded sprayer along the row for weed control. This can cause problems with less crop competition for weeds, and greater reliance on herbicides and tillage. Research also found that the crop seeding rate had a greater effect than row spacing on competitive ability. The continual use of non-selective herbicides such as glyphosate with shielded spraying operations has already heightened the incidence of resistance, so this method is not sustainable.

Inter-row sowing does not work so well if stubbles have been grazed, so may not be adopted by mixed farmers who need crop stubble as a feed source for livestock over summer.

Lower risk of moisture deficit at grain fill (Yield & Quality increase)

With wider rows crop plants have access to moisture in a larger volume of soil which helps ensure that there will be moisture available in spring. Crops sown on wide rows produce less biomass, which can leave more water for use during flowering and grain-fill. The negative aspects of this is crops on wide rows do not intercept as much radiation, more water is lost to evaporation, and crops are potentially less competitive with weeds that will use the moisture and increase weed seed production (affecting following crops).

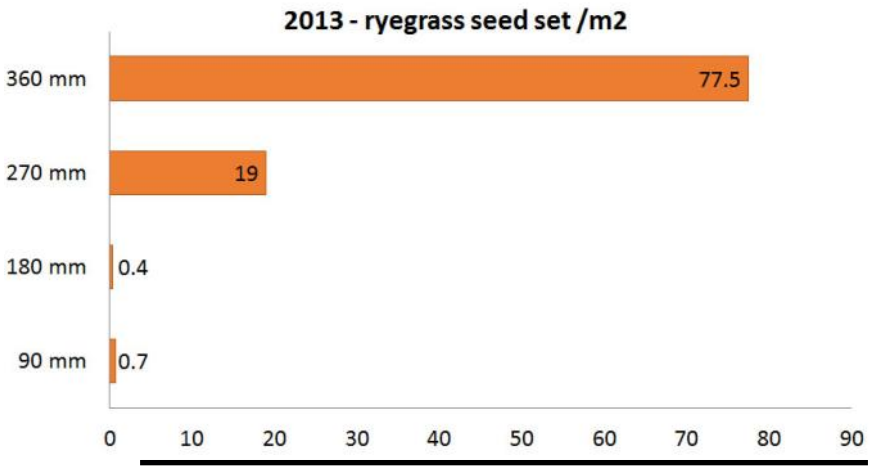
Photo 1 - Derek Ingold explains how he adapted sowing gear. Adapting equipment to give better trash flow was often the entry point into no-till farming Photo: Tony Pratt

Grain yields reduced in med-high yield areas

A recent review of use of wide row spacing showed that in medium to high rainfall areas increasing row space beyond 18cm gave yield declines.

High yielding crops (>3 t/ha) require all photosynthetically active radiation to be intercepted during the critical period ~30 days prior to anthesis. This allows rapid growth which increases the number of grains set per spike, which in turn increases grain yield. Ideal plant populations are in the range 100-150 plants /m2. As plant populations are increased there is an increase in crop competition within the row and higher mortality of seedlings, so it is often counter-productive to increase seeding rate in wider row spacing.

TABLE 1 - Glen Riethmuller. After 27 years of the row spacing experiment, the annual sowing of crops on narrow row spacing using normal pre-emergent herbicides had reduced the annual ryegrass seed set to very low numbers in Merridin WA. ***Ref: Borger CPD, Riethmuller G and D'Antuono (2016). Eleven years of integrated weed management: long term impacts of row spacing and harvest weed seed destruction on Lolium rigidum control. Weed Research (In press)***



Why NOT use wider rows?

Less competitive crops for weeds

Herbicide resistant weeds are a major problem facing grain farmers at present. Evolution of resistance to herbicides can be slowed if cultural methods such as weed competitive crops are used. Achieving ground cover as soon as possible (earlier sowing, higher sowing rates and narrow row spacing) increases crop competition. Wider rows also give more space for weeds and this can lead to greater seed production, affecting future crops.

Increased fertiliser toxicity risk

In-row concentration of fertilisers are higher in wider rows. The use of narrow knife point tines or discs further decreases the proportion of a paddock taken up by the seed bed (seed bed utilization – SBU) and further increases the concentration of fertilizer in the seeding row. These increases in concentration and proximity cause toxicity to seed and seedling plants from higher salt concentrations, higher osmotic effects for plant roots, ammonia production and high levels of toxic impurities (eg biuret) in some products. Some of these effects can be changed by using different formulations, or by following guidelines for crop safety of different fertilizer products at different SBUs. When row space is increased this lowers the SBU, and as such lowers the rate of fertilizer that can be safely sown with the seed. There are engineering solutions to increase SBU (e.g. splitting or paired-row boots) and also to separate seed and fertilizer e.g. deep or side-banding.

(See tables at RIGHT, taken from the GRDC fertilizer toxicity Fact Sheet 2011)

Groundcover reduced

Wider row spacing slows the overall production of biomass and delays canopy closure. Consequently the crop captures less sunlight and more soil water is lost to evaporation from the inter-row soil surface. This limits the amount of intercepted radiation required for growth and setting of yield potential. Whilst there is some variation due to climate (amount of in season vs. fallow rainfall) and soil type, in general yields would are reduced in higher yielding areas.

Increased crop competition within rows

If row spacing increases while maintaining consistent plant population, then the number of plants per linear metre of row increases. This means that individual plants will be closer together and competing for moisture and nutrients. This can affect young seedlings before their roots have expanded into the inter-row space. Increased crop competition can lead to lower growth rates, which can affect the time that the crop takes to give canopy closure and how efficient the whole crop is at intercepting sunlight. In turn this will have an effect on the yield potential. Some less vigorous seedlings may be choked out by stronger seedlings leading to reduced crop establishment rates. Many crop plants are good at compensating for different stresses such as increased competition from other plants, moisture availability or shading from neighbouring plants. Plants will reduce tillers or branches, affecting leaf area and ultimately yield.

Table 1 Differences in seed bed utilisation for a range of seeding points and boot combinations.

Seeding point	Common seed spread (mm)	% seed bed utilisation (SBU)		
		Row spacing (mm)		
		150	225	300
125mm share	65	43	29	22
65mm share	46	31	20	15
Single side band opener	36	24	16	12
Spear point	25	17	11	8
Inverted T	25	17	11	8

SOURCE: GRDC

Table 2 Approximate safe rates[1] of N as urea, mono-ammonium phosphate (MAP) or di-ammonium phosphate (DAP) with the seed of cereal grains if seedbed has good soil moisture (at or near field capacity).

	25mm (1") seed spread[2]			50mm (2") seed spread[2]		
Soil Texture	Row spacing			Row spacing		
	180mm (7")	229mm (9")	305mm (12")	180mm (7")	229mm (9")	305mm (12")
	SBU[3]			SBU[3]		
	14%	11%	8%	29%	22%	17%
Light (sandy loam)	20	15	11	40	30	22
Medium-Heavy (loam to clay)	25	20	15	50	40	30

Table 3 Approximate safe rates of P with canola seed if seedbed has good soil moisture (at or near field capacity).

	25mm (1") seed spread[2]			50mm (2") seed spread[2]		
Fertliser Type	Row spacing			Row spacing		
	180mm (7")	229mm (9")	305mm (12")	180mm (7")	229mm (9")	305mm (12")
	SBU[3]			SBU[3]		
	14%	11%	8%	29%	22%	17%
DAP (18:20:0)	8	6	5	17	13	10
MAP (10:22:0)	10	8	6	21	16	12
Triple Super (0:20:0)	27	21	15	55	42	33
Single Super (0:9:0)	15	12	9	31	24	18

1 Based on Australia and Canadian tolerance models.

2 Width of seed spread must be checked under field condition. Width of spread varies with air flow, soil type, moisture level, amount of stubble and other soil conditions.

3 SBU is the amount of the seedbed over which the seed/fertiliser has been spread.

These models are yet to be confirmed and are a guide only – use half these rates in dry soil.

SOURCE: Rainbow RW and Slee DV (2004), *The Essential Guide to No-till Farming* (South Australian No-Till Farmers Association).

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Cost benefit analysis

The value of these yield reductions should be taken into account when considering farming system options with retained stubble. The likely economic loss from row space widening needs to be offset by the economic advantages of the minimum till, stubble retention system. At low yield it is easy to justify the decision to widen row space. However, at higher yield levels (eastern NSW wheatbelt or under irrigation) the loss of yield with widening of rows increases, and the offset benefits of the stubble retention system need to be carefully evaluated. If not sufficient to make up for the loss associated with wide rows, then alternative methods of retaining stubble should be investigated. Methods of sowing into stubble using narrower row spacing include the use of disc seeders or trash reduction by mulching, baling, grazing or burning. These options should be considered before wide rows.

Row Spacing			
18 cm	25 cm	30 cm	42 cm
	Wheat Yield (cost/benefit)		
0.50	0.502 (+$0.6)	0.504 (+$1)	0.508 (+$2)
1.00	0.98 (-$5)	0.97 (-$8)	0.93 (-$16)
2.00	1.94 (-$15)	1.89 (-$27)	1.79 (-$53)
4.00	3.85 (-$35)	3.75 (-$63)	3.49 (-$127)
6.00	5.77 (-$58)	5.70 (-$100)	5.20 (-$200)
	Canola yield (cost)		
1.00	0.96 (-$18)	0.94 (-$31)	0.87 (-$63)
2.00	1.94 (-$28)	1.91 (-$47)	1.81 (-$95)
3.00	2.93 (-$37)	2.87 (-$64)	2.74 (-$127)
4.00	3.91 (-$47)	3.84 (-$80)	3.68 (-$160)

Table 1. Yield in t/ha and economic cost or benefit ($/ha) of using wide row sowing with wheat and canola in central and southern NSW (wheat at $250/t and canola at $500/t).

There is no substitute for good agronomy

Good agronomy is the right combination of genetics (crop and variety), management (crop type and variety selection, planting times, sowing rates, sowing depth, fertility, weed, disease and pest control) and environment (soil type, rainfall, temperatures) and determines crop yield and quality. Management factors are decided by farmers and agronomists each season based on the predicted seasonal conditions and past experiences. For each region there is an ideal combination of many factors that achieves the best result, and row spacing is just one of these factors.

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