CROP PLACEMENT AND ROW SPACING FACT SHEET

GRDC Grains Research & Development Corporation

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NORTHERN REGION

A systems approach to row spacing

The depth of seed placement and the distance from the adjacent row both influence crop performance. With the greater uptake of no-till and precision farming the opportunities to vary row spacing by crop and sow on the inter-row have increased. However, increasing row spacing is not always beneficial to yield.

KEY POINTS

- Increased interest in no-till farming has created a trend for wider crop row spacing.
- In general, increasing row spacing up to 50 centimetres has minimal effect on cereal yield when yield potential is less than 2 tonnes per hectare.
- In higher rainfall areas, where cereal crops have higher potential yields, significant yield decreases have been recorded with wider row spacing (greater than 25cm).
- The yields of broadleaf crops vary in their response to wider row spacing.
- Row spacing in sorghum should be based on expected yield.
- Precision agriculture allows for easier inter-row sowing and fertiliser applications at wider row spacing.

PHOTO: RICHARD ROUTLEY

The higher the yield potential, the greater the negative impact of wider rows on wheat and barley yields.

Adoption of no or zero-till farming systems and drier seasons have increased interest in the use of wider row spacing as a method to manage crop residues and conserve soil moisture.

The most appropriate row spacing is a compromise between crop yield, ease of stubble handling, optimising travel speed, managing weed competition and soil throw and achieving effective use of pre-emergent herbicides.

Although row spacing is relatively simple to change, the effect on the whole farm system can be complex and can influence grain yield, time of sowing, machinery, herbicide, seed and fertiliser costs, and weed management, as well as the configuration of other crops sown in the rotation.

Effect on yield

Winter cereals

The effect of row spacing on wheat and barley yield varies depending on the growing season rainfall, time of sowing and the potential yield of the crop. The higher the yield potential, the greater the negative impact of wide rows on cereal yields. There is some variation in responses to row spacing greater than 40cm among cereal varieties. Early research on recently released bread and durum wheat varieties suggests some new varieties may have a more stable yield across wider row spacing.

In the low rainfall western cropping areas of the GRDC Northern region, cereals are grown on wide row spacings, up to 50cm, to conserve water and reduce haying-off at grain fill. Cereals grown on wider row spacing tend to be taller and this creates the potential for lodging in high yielding years.

In higher rainfall areas where yield potential is greater than 3.5t/ha, yield decreases when row spacing is increased. Recent trials at Spring Ridge, New South Wales, found 30cm row spacing produced significantly higher yields than 40cm spacing, which was too wide to reach the yield potential (Figure 1). This yield loss equates to 0.5t/ha for every 10cm increase in row spacing.

In central Queensland, trials compared the effect of 25, 37.5 and 50cm rows on wheat yields. For yields up to 2t/ha there was no effect on increasing row spacing up to 50cm. When average yields were between 2t/ha and 4t/ha, there was a 0.2t/ha yield reduction when rows were widened from 25 to 37.5cm. The yield reduction was 0.3t/ha when the row spacing went from 25 to 50cm. The greatest penalties occurred in crops where the average yield exceeded 4t/ha, with a reduction in yield of 0.6t/ha when rows were extended from 25 to 37.5cm, while the average yield loss was 0.5t/ha when row spacing went from 25 to 50cm.

Broadleaf crops

Pulse yields are more tolerant of wide row spacing than cereals.

Chickpeas

Planted on a row crop configuration (up and back on 50 to 100cm rows) chickpeas can benefit from a reduced incidence of ascochyta blight by improving airflow between the rows. The wider row spacing can reduce spray costs by allowing for banded spraying. Harvesting height is improved if the chickpeas are sown on the inter-row, between the rows of the previous cereal crop. This enables the standing stubble to act as a trellis. Newer chickpea varieties with genetic resistance to ascochyta blight may result in a re-evaluation of row spacing for this crop in the future.

Field peas

Row width for field peas should be 25cm or less if sown into bare fallows but can be increased to 15 to 35cm planted into standing stubble.

Mungbeans

As a break crop, mungbeans are often sown at 50cm to 1m row spacing as this suits the configuration of machinery used for the primary crops. However, mungbeans can be sown at narrower row spacing. Narrow rows (less than 50cm) have a higher yield potential, where yields are likely to be greater than 1t/ha. Data suggests the yield increases from narrow row spacing can be as much as 10 to 15 per cent, for potential yield of 2t/ha.

Canola

In NSW, trials have evaluated canola sown on 18, 24 and 36cm rows but results have been inconclusive. Poor seasons have resulted in variable information on how plant density has translated into yield and more research is currently underway.

A series of canola trials in Western Australia has shown an average yield loss of 13.7 per cent by widening row spacing from 18 to 36cm. Recent trials with *Brassica juncea* at Coonamble and Edgeroi, NSW, showed significant yield losses of approximately 20 per cent on a 1.8t crop when row spacing moved from 30 to 45cm for late sowing. The yield loss was less with earlier sowing.

Sunflower

Several row spacing configurations have been tried in sunflower, including skip row (every third row missed), wide rows (1.5m spacing) and the standard 75cm spacing. Preliminary trials conducted by Pioneer Hi-Bred Australia and AgriScience Queensland, DEEDI in central Queensland indicated that 1.5m row spacing can offer better utilisation of moisture when available moisture is scarce, helping to maintain yield. Other benefits include more even flowering and maturity, faster maturity by up to 10 days, cleaner harvest and lower planting seed costs. However, weed control can become more difficult under wider row spacing.

Sorghum

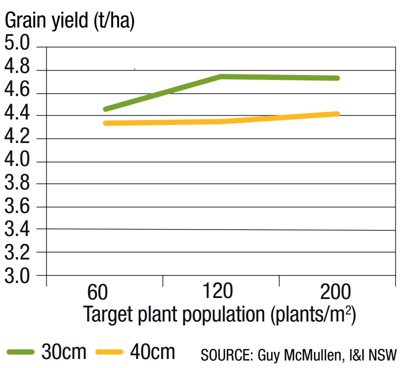
The traditional spacing for sorghum is 60cm to 1m depending on machinery configurations and expected yield (Table 1). Narrow rows typically out-yield wide rows under good growing conditions and are more appropriate in high rainfall environments or with irrigated crops.

The lack of soil moisture in dry years has resulted in wider and skip row configurations being used to improve yield reliability. In some areas there has been a move to grow sorghum on ultra wide 1.5m rows. Single skip (two rows 1m apart with a 2m spacing followed by two rows 1m apart) and double skip (two rows with a 3m spacing before another two rows) have become popular as a way of conserving soil moisture.

Wide and skip row configurations promote yield stability, particularly in low yielding years by limiting crop water use during the crop vegetative phase and, therefore, maximising the water available during flowering and grain fill. There is a cost in reduced potential crop yield in a good year. The increased post-flowering water availability in a skip row configuration reduces the risk of crop failure in a dry year.

The choice of row spacing can be made at the time of sowing after assessing the water content of the soil profile and seasonal outlook. The extra wide row and skip row configurations enable a shielded sprayer to be used for weed control.

FIGURE 1 Significant reductions in cereal yield when row spacing increased from 30 to 40cm



SOURCE: Guy McMullen, I&I NSW

TABLE 1 Suggested row configurations for potential sorghum yields in Queensland and New South Wales

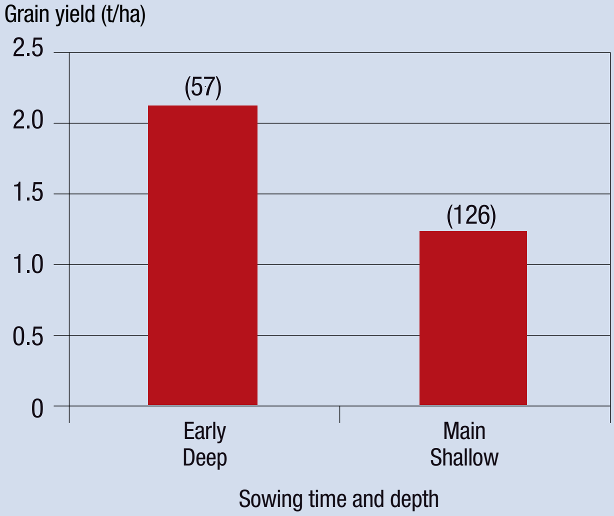
Potential yield	Optimum row spacing
Above 4t/ha	1m or less
3 to 4 t/ha	1m
Below 3t/ha	1m or more and skip row configurations become an option

SOURCE: Guy McMullen, I&I NSW

Seeding depth

The difference in emergence and development between wheat sown at 30 to 35mm and sown too deep or shallow.

FIGURE 2 The effect of sowing depth and the time of sowing



(Early = May 23, Main = June 19) on barley yield and establishment in 2007 (plants/m[2] in brackets)

Crop establishment is a critical component in maximising crop yield. Seeding depth is an important factor in achieving even plant populations and more recently has influenced growers' ability to sow on time.

Factors which influence a seedling's ability to emerge from depth include seed size, seed treatments and herbicides, coleoptile length (varies with variety), soil conditions and temperature.

Unnecessarily sowing too deep can delay emergence, reduce establishment of early seedling vigour, increase disease susceptibility and reduce yields. In some seasons moisture seeking or deep sowing is a tool that can ensure crops are established in their optimal sowing window.

Deeper sowing may reduce plant populations, but the yield from the earlier sowing may offset any potential yield losses and increase yields compared with delaying sowing to later in the season. In 2007, trials at Yallaroi in northern NSW compared the deep sowing of a range of barley varieties against delayed sowing at a shallower depth. This trial clearly showed the impact of deeper showing on plant establishment with half the plants established compared to the shallow planting (Figure 2).

The main effect was that earlier sowing and crop establishment, using deep seed placement, provided a 1t/ha yield advantage. Grain quality was also greatly improved with lower screenings compared to the later sowing.

Although the ideal seeding depth for wheat and barley is 30 to 70mm this will vary based on variety. Research in barley has shown that most commercial varieties respond similarly to deep sowing. Two exceptions to this in recent research have been Hindmarsh⌽ and Fitzroy⌽ that have not emerged as well from depth. Caution should be taken with these varieties when deep sowing.

Some fungicidal seed treatments can also reduce coleoptile length and seedling vigour in cereals and treated seeds should be shown at as shallow a depth as possible.

The ideal seeding depth for sorghum is between 20 to 50mm.

Canola has small seeds and should be sown shallow with the ideal depth 12 to 25mm.

Pulses such as chickpeas and field beans, which have hypogeal emergence where the cotyledons remain where the seed is sown and only the shoot emerges from the soil, tolerate sowing at depths of 50 to 80mm.

A more uniform seeding depth is achieved with press wheels which minimise the variation in soil cover, provided they leave a regular, stable furrow.

PHOTO: GUY MCMULLEN

Wide and skip row configurations (ultra wide at 1.5m shown) promote yield stability, particularly in low yielding years, by limiting crop water use during the crop vegetative phase. There is a cost in reduced potential crop yield in a good year.

Closer row spacing can reduce evaporation by increasing the rate of canopy closure. Wider row spacing can increase evaporation from the soil between the rows but this can be offset by inter-row stubble retention.

Skip row configurations in sorghum result in crop residues being left in bands after harvest, leaving inter-row spaces bare of cover. Reduced stubble cover can cause increased run-off and soil loss and reduced infiltration and fallow water storage. This can make inter-row areas difficult to 'wet-up' and can restrict future planting options.

The effect of reduced soil water accumulation in the following crop needs to be weighed up against the enhanced yield of the current crop in a dry season.

Any extra water accumulated during a fallow period can dictate whether or not a crop can be sown in the following year.

Weed competition

Increasing row spacing can create weed problems. Wider spacing reduces the crop's ability to close the canopy and compete with weeds between rows. This delays inter-row weed suppression – the wider the rows the longer the delay.

As row spacing increases to more than 40cm in cereals, canopy closure may never occur making weed control extremely important.

Wider row spacing allows for weeds to be controlled using higher rates of incorporated by sowing (IBS) herbicides, such as trifluralin and pendimethalin, with tined seeders where a 'hot blanket' of herbicide is incorporated in-between the crop rows.

Wide row spacing in some crops enables weeds to be controlled through inter-row cultivation and creates the potential to use a shielded sprayer to control weeds between crop rows.

Equipment

Wide row spacing can cut machinery costs by reducing the number of sowing units on a machine. Consequently, less fuel and possibly a smaller tractor could be used for sowing.

Increased sowing speeds are also possible. Wider row spacing reduces soil throw and the impact of pre-emergent herbicide being thrown from one row into an adjacent row, where it can reduce crop emergence. Soil throw distance increases with the square of speed. That is, doubling the speed will increase soil throw distance by four. So, speed can increase approximately 1.4 times if row spacing is doubled.

Wider row spacing can improve the stubble handling ability of seeding equipment. There can be problems when stubble loads are heavy.

Discs are ideal for stubble retention but are not as versatile as tined machines, which can be easily reconfigured for different crop and soil

Inter-row sowing can improve stubble flow and help establishment. The best results are achieved with row spacings of 30cm or more and using +/-2cm accuracy guidance and autosteer. Row spacing for cereals and pulses is often determined by sorghum.

conditions. Triple disc seeders are less efficient at herbicide incorporation and pre-planting weed control than tined or culti-trash machines.

Culti-trash machines are good at handling heavy stubbles but make it difficult to control seed depth and can result in inconsistent establishment. Tined machines are less able to cope with stubble than disc seeders and often require preparation of the stubble at harvest.

Inter-row cropping

In combination with GPS guidance that provides at least +/-10cm accuracy and autosteer, wide row spacing allows subsequent crops to be located on the inter-row. Inter-row systems can improve stubble flow but it is important that tines do not catch the stubble row as this can cause establishment problems.

When RTK guidance provides +/-2cm accuracy, the best results are achieved when the minimum wide row spacing is approximately 30cm.

Wider row systems can potentially help with the move to disc seeders and full zero-till systems.

Inter-row sowing spacing with cereal and pulse crops is often determined by the spacing used for sorghum.

Fertiliser

Fertiliser rates may need to be refined for wide row spacing. Wider row spacing can result in an increased concentration of fertiliser in rows or a reduced fertiliser rate per hectare at seeding. Consequently, changes in the amount of fertiliser applied at seeding and additional fertilisation during the growing season may be required with wider row spacing.

Increased fertiliser requirements can occur when there is incomplete exploration of the surface soil by plant roots, such as in dry years.

Banding fertiliser below the seed will help minimise the effects of fertiliser toxicity. This can occur if seeding fertiliser rates are maintained but row spacing increased.

Soil fertility can also vary between the row and inter-row space in wide row cropping systems. There may be residual applied phosphorus in the crop following a dry year. Nitrogen fixation following pulses or nutrient tie-up by stubble can affect soil fertility. This can influence the fertiliser required for the following crop.

To establish soil nutrient status in systems using wider row spacing a modified approach to soil sampling is suggested. Take equal numbers of soil samples from the row and inter-row for an average fertility content of the paddock.

If planning to precision sow (row or inter-row) there may be some value in having the row and inter-row samples tested separately. This will allow any potential variation in soil fertility to be exploited.

Sowing into an area of high residual phosphorus or nitrogen may reduce starter fertiliser requirements, while sowing away from residual fertility will delay crop access.

Options

Many no-till operations are sowing cereals and canola on 30cm rows and pulses on 30 to 65cm rows between the standing stubbles.

It is important to do a critical and economic assessment of the benefits and costs of increasing row spacing.

Benefits

Wider row spacing allows:

- crops to be sown into in greater amounts of retained stubble;
- an opportunity for better moisture conservation for grain filling;
- a reduction in fuel costs during sowing and/or increased sowing speeds;
- the potential to inter-row sow in subsequent crops;
- the option of applying higher rates of truifluralin (which may be necessary with high levels of retained stubble and poor soil incorporation) to improve grass weed control;
- reduced soil disturbance; and
- reduced cost of machinery.

Costs

Potential costs include:

- lower yields with wider row spacing;
- greater weed competition;
- slower canopy closure by crops;
- increased evaporation from soil;
- an increased need to band fertiliser or modify fertiliser application as higher levels can become toxic when concentrated in wider rows; and
- greater potential for lodging.

Useful resources:

- **Guy McMullen, Industry & Investment NSW** — **02 6763 1100, Email guy.mcmullen@industry.nsw.gov.au**
- **Richard Routley, AgriScience Queensland, DEEDI** — **07 4688 1174, Email richard.routley@deedi.qld.gov.au**
- **Peter Martin, Industry & Investment NSW** — **02 6938 1999, Email peter.martin@industry.nsw.gov.au**
- **Deciding row spacing for wheat in central Queensland** — **www.dpi.qld.gov.au**
- **Northern Grains Region Spring 2010, Research & Extension – Independent Research for Industry** — **www.dpi.nsw.gov.au**
- **Northern Region Field Pea Management Guide** — **www.dpi.nsw.gov.au**
- **Summer Crop Production Guide 2010** — **www.dpi.nsw.gov.au**
- **GRDC Grains Research Update, Northern Region, December 2002, Issue 40**
- **A Guide to Sunflower production: The Big Black Sunflower Pack. Australian Sunflower Association** — **www.australianoilseeds.com**
- **Other related GRDC fact sheets** — **www.grdc.com.au/director/events/factsheets**

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