CROP PLACEMENT AND ROW SPACING FACT SHEET

GRDC
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SOUTHERN 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 opportunity 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.
- Generally, increasing row spacing up to 30 centimetres has no effect on wheat yield, when yield potential is less than 3.5 tonnes per hectare.
- Significant yield reductions in cereals have been recorded with wider row spacing in high rainfall areas with high yielding crops.
- The yields of broadleaf crops vary in their response to wider row spacing.
- Inter-row sowing into standing stubble is essential in crops susceptible to lodging to maximise the benefits of wider rows.
- Precision agriculture allows for inter-row sowing and fertiliser applications at wider row spacing.

PHOTO: EMMA LEONARD

Generally, increasing row spacing up to 30cm has no effect on wheat yield, where yield potential is less than 3.5t/ha.

The traditional row spacing in much of southern Australia has been 15 to 20cm (six to eight inches, for measurement conversions see Figure 1). Greater adoption of no-till farming systems has increased interest in wider row spacing such as 30 to 50cm, depending on the crop type and region.

Row spacing is a compromise between:

- ease of stubble handling;
- optimising seedbed utilisation and 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. The change can influence yield, time of sowing, machinery choice and setting, herbicide type, seed costs and fertiliser type and timing. Using different row spacing for different crop types will influence the types of crops sown and their sequence in the rotation.

Effect on yield

Cereals

The impact of row spacing on yield varies depending on the growing season rainfall.

Wide row spacing at 30cm has been shown to improve both wheat and barley yields slightly where the yield potential is low (less than 1t/ha), in trials in the Victorian Mallee. Other trials on wide row spacing and the effect on yield in cereal crops with low yield potential (1 to 2.5t/ha) have been inconclusive.

Generally, increasing row spacing up to 30cm has no effect on wheat yield, when yield potential is less than 3.5t/ha.

In higher rainfall zones, where yields are above 3.5t/ha, significant yield decreases have been recorded in crops with wider row spaces. Trials conducted over three consecutive years by the Southern Farming Systems near Geelong, Victoria, have shown 40cm row spacing reduced wheat yield in the order of six per cent compared with 20cm row spacing.

The higher the yield potential, the greater the negative impact of wide rows on cereal yields.

Cereals grown on wider row spacing tend to be taller, creating the potential for lodging in high yielding years. At harvest crop lifters may be required.

The ideal row spacing for oaten hay is around 17.5cm. This reduces stem diameter, avoids lodging and keeps the hay windrow off the ground during curing. Cross sowing at wider row spacing may achieve the same result.

Broadleaf crops

Pulse yields are more tolerant of wide row spacing (30 to 60cm) depending on rainfall.

Trials in the Victorian Mallee and Wimmera, with a range of pulses, found crops grown on 30cm rather than 20cm row spacing tended to have similar yields. Field peas and lentils have shown no yield loss when row spacing is increased to 30cm. Lupins and chickpeas have shown yield loss on rows spaced at 60cm. However, these trials were in dry years and no data is available on pulses in wetter years.

Pulses such as lentils and chickpeas grown on wide row spacing (30 to 60cm) with standing stubble as a trellis, generally have a greater podding height and improved harvestability. Both of these can result in improved yields, particularly in better seasons.

Increasing row spacing in pulses also allows:

- greater water use from the inter-row;
- reduced disease by increasing airflow and improving penetration of fungicides into the canopy; and
- reduced spray costs if banded spraying is used.

Chickpeas sown on wide rows (60cm) into cereal stubble on 30cm rows. The trellising effect of the cereal stubble helps increase podding height and harvestability.

FIGURE 1 Common row spacings in metric and imperial measurements

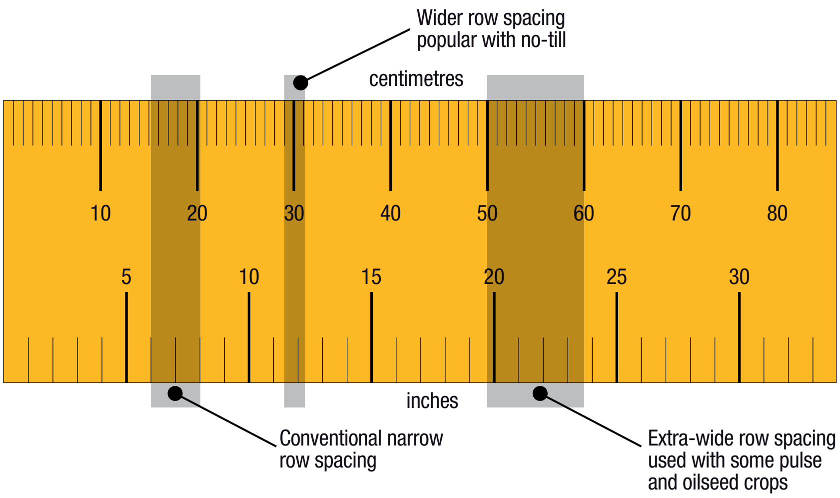

TABLE 1 Crop yield responses to row spacing in SA, 2006

	Mean (t/ha)		
Row spacing	Wheat	Barley	Faba bean
18cm	2.80	3.02	0.79
36cm	2.66	2.95	0.98
54cm	2.13	2.49	0.95

SOURCE: Gurjeet Gill and Sam Kleeman, University of Adelaide

Seeding depth

PHOTOS: EMMA LEONARD

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

In canola, poorer germination occurs with smaller seed.

Appropriate seeding depth is important for maximising crop yield.

Factors that influence a seedling's ability to emerge from depth include:

- seed size;
- seed treatments;
- coleoptile length (this varies with variety);
- herbicides; and
- soil conditions including temperature.

Sowing too deep can delay emergence and establishment, reduce early seeding vigour, increase disease susceptibility and reduce yields.

In season with a dry start, deep sowing into moisture is a tool that can ensure crops are established in their optimal sowing window. The deeper sowing may reduce crop germination, but the yield from the earlier sowing may offset yield losses associated with delaying sowing to later in the season.

Deep sowing is only an option for soils that store soil moisture and can be cultivated to depth. Care should be taken to avoid bringing sodic clays into the topsoil, which can increase dispersion, hard-setting and salinity. Some fungicidal seed treatments reduce coleoptile length in cereals and treated seeds should be shown at shallower depths.

A more uniform seeding depth is achieved with press wheels, which minimise the variation in soil cover, provided they produce a regular, stable furrow. The ideal seeding depth for wheat is 30 to 35mm for semi-dwarf varieties, through to 50 to 70mm for tall wheat varieties, which have a longer coleoptile length.

Barley has a shorter coleoptile length than wheat and the ideal sowing depth is 20 to 30mm. Some barley varieties including Hindmarsh⍦ and Buloke⍦ have shorter than average coleoptile length. Deep sowing with these varieties is not recommended, especially with stubble retention, the use of seed fungicides containing triadimenol, or with pre-emergent weed control using trifluralin.

Canola has small seeds and should be sown shallow with the ideal depth 12 to 25mm. Poorer germination occurs with smaller seed.

Lupins should be sown at 30 to 50mm. Yellow lupin is particularly sensitive to deep sowing and should not be sown deeper than 30mm.

Pulses such as chickpeas and faba 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. Pulses must be sown below the depth at which herbicide is incorporated.

PHOTOS: ROB RUWOLDT

Wheat sown on the inter-row of wide row canola. When using different row spacings for different crops, issues such as machinery set-up, stubble management at harvest and fertiliser placement need to be considered. Inter-row seeding can improve stubble flow and provide trellis for pulse crops.

Canola trials in New South Wales have evaluated 18, 24 and 36cm rows and have been inconclusive. A series of trials in Western Australia found an average yield loss of 13.7 per cent by widening row spacing from 18 to 36cm.

Soil moisture

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 mulching and the interception and concentration of rainfall into the crop row.

Field experiments in SA during 2006 investigated the water and radiation use efficiency of wheat, barley and faba beans grown on conventional (18cm) and wide row spacing of 36 and 54cm (Table 1, see page 2). The trial was conducted during a dry season (growing season rainfall 181mm; median 300mm) and found clear differences in the yield responses for the crops grown at different spacing.

The yield trends for wheat and barley were similar, irrespective of row spacing. Doubling the row spacing from 18 to 36cm resulted in a two per cent loss in yield in barley and a five per cent loss in wheat. When row spacing was extended to 54cm a yield reduction of up to 24 per cent was recorded in both cereals.

In contrast, the yield for faba beans increased significantly with wider row spacing. Faba beans grown on 36cm rows had a 24 per cent higher yield than the crop grown on 18cm rows. The yield from faba beans grown on 54cm rows was still 20 per cent higher than the 18cm row spacing. The increased yield was due to an increased number of pods per plant at both of the wider row spacings.

It was established that the faba beans in wider rows (36 and 54cm) used less water during the early stages of crop development, so more water was available later in the season for grain filling. This contrasts to the findings in wheat and barley where water use was unaffected by row spacing.

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. At row spacing greater than 40cm canopy closure in cereals may never occur. This makes weed control extremely important.

Wider row spacing can allow weeds to be controlled using higher rates of incorporated by sowing (IBS) herbicides. Trifluralin and pendimethalin can be applied as a 'hot blanket' of herbicide and incorporated between the crop rows using a seeding bar fitted with tines not discs.

Trials by the Birchip Cropping Group in the Victorian Mallee found reduced plant establishment can occur when relatively high rates of pre-emergent herbicide are used with narrower row spacing (less than 22.5cm). Slightly higher seeding rates can be used to compensate for these reductions. The risk of crop damage from pre-emergent herbicides used with wide row spacing is greatly reduced.

PHOTO: EMMA LEONARD

In a dry season, increasing row spacing from 18 to 36 and 54cm resulted in yield penalties in wheat and barley but no difference in water use was recorded with different row spacings.

When modifying row spacing do not leave tines in the ground that are not used for seeding. These stimulate the germination of ryegrass and throw herbicides out of the furrow, encouraging the ryegrass to grow unchecked. Removing tines also saves fuel and allows faster and easier seeding.

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, but 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 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, 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 using RTK guidance that 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.

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 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 phosphorus in the soil following a dry year. Nitrogen fixation following pulses or nutrient tie-up by stubble may 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 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;
- 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:

- **Peter Martin, Industry & Investment NSW** — **02 6938 1999, Email peter.martin@industry.nsw.gov.au**
- **Simon Craig, Birchip Cropping Group** — **03 5382 0477, www.bcg.org.au**
- **Jason Brand, Department of Primary Industries Victoria, Horsham** — **03 5362 2341, 0409 357 076**
- ***Wide row pulses and stubble systems*, Southern Pulse Bulletin, Wayne Hawthorne, Pulse Australia, South-Central** — **www.pulseaus.com.au**
- ***Wide-row cropping for weed management opportunities*, Gurjeet Gill and Sam Kleeman, 2008 South Australian GRDC Grains Research Update**
- **Row Spacing in a no-till system – Birchip Cropping Group** — **www.bcg.org.au**
- **Farming in the Mallee with GPS guidance** — **www.dpi.vic.gov.au**
- **Other related GRDC fact sheets** — **www.grdc.com.au/director/events/factsheets**

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