Performance of first wheat after canola under no-till full stubble retention (NTSR) using different drill openers and row spacing at Coreen

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Key points

- In the 2012 wheat after canola trial, moving from a narrow row spacing (22.5cm) to a 30cm spacing reduced yield by 9%. Moving from 22.5cm to the widest (37.5cm) row spacing reduced yield by 11%.
- In a season where yields averaged about 3t/ha overall (based on a GSR of 196mm plus 85mm stored soil moisture), increasing row spacing beyond 22.5cm significantly reduced yield.
- During 2009, in the same rotation position on the same trial site, there was no difference in yield between the 22.5cm and 30cm row spacings (based on 2.5t/ha average yields), although the 37.5cm row spacing still yielded significantly less.
- The narrowest row spacing (22.5cm) produced more biomass than the wider row spacing and converted this biomass into higher grain yield, giving a harvest index (HI) of 29%.
- There was no difference in crop establishment, biomass or grain yield due to type of drill opener used (tine versus disc).
- The narrow row spacing was estimated to result in better water use efficiency (WUE) than the wider spacing, despite having a lower HI. During 2009, the advantage of higher biomass in the 22.5cm row spacing was equally counterbalanced by the higher HI in the 30cm row spacing. During 2012, this was not the case and the higher biomass of the narrower row spacing had the greater impact on grain yields.

Location: Coreen, NSW

Rainfall:
- Annual: 475.5mm (2012)
- GSR: 196mm (Apr–Oct)
- Stored moisture: Estimated 85mm (estimated at 35% fallow efficiency of 242mm)

Soil:
- Type: Loam clay
- pH (H_2O): 5.8 (2011)
- pH ($CaCl_2$): 5.3 (2011)
- Colwell P: 86mg/kg (2011)
- Deep soil nitrogen: 46 kg/ha (2011)

Sowing information:
- Variety: Spitfire sown at 85kg/ha
- Sowing date: 17 May 2012
- Sowing rate: 85kg/ha
- Fertiliser: 85kg/ha MAP + Intake
- Sowing equipment: Janke tine with Janke presswheel. Single disc opener.
- Treatments: Establishment method x row spacing

Row spacing: 22.5cm, 30cm, 37.5cm

Paddock history:
- 2011 — canola
- 2010 — wheat
- 2009 — wheat

Plot size: 44m x 3m

Replicates: 4 (disc) 8 (tine)

Overall goal

Improved water use efficiency (WUE) in no-till cropping and stubble retention systems in spatially and temporally variable conditions in the Riverine Plains.

Aim

The aim of this trial was to evaluate the performance of different drill openers at a range of row spacings in the first wheat crop after the break crop (canola).

Method

A replicated experiment was established to test the effect of a range of drill openers and row spacings on the first wheat crop after the break crop of canola as part of a four-year cropping rotation trial. The 2012 wheat crop was the fourth successive crop superimposed on the original no-till stubble retention trial site.

- 2008 — canola (farm crop)
- 2009 — wheat
- 2010 — wheat
- 2011 — canola
- **2012 — wheat**

Crop stubble from the previous year's canola crop trial was chopped and spread at right angles to the direction of plots.

Results

Crop establishment

Wheat was established into the stubble of the previous 2t/ha canola crop. Plant establishment assessed 26 and 40 days after sowing showed that the 22.5cm row spacing had significantly superior plant establishment to the 30cm row spacing, which in turn was significantly superior to the 37.5cm row spacing (see Table 1 and Figure 1). There was no statistical difference in plant establishment between the tine and disc openers at either the one-leaf or three-leaf stages (see Figure 2). This trial showed the same significant results as an identical trial carried out on the same site during 2009, following the same break crop (see *Research for the Riverine Plains 2010*, p14).

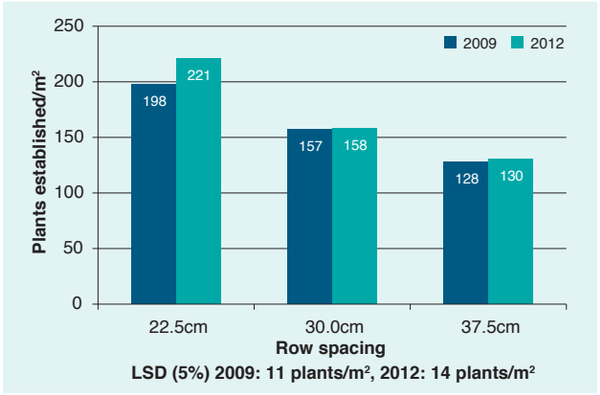

FIGURE 1 Influence of row spacing on plant establishment at the three-leaves-unfolded stage (GS13) in the first wheat following canola in 2009 and 2012 established on the same site*

* Mean of both drill openers

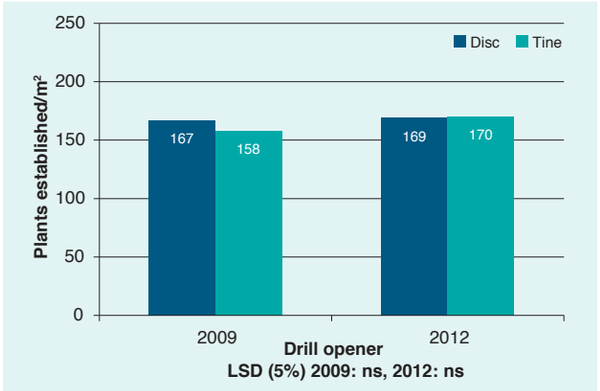

FIGURE 2 Influence of drill opener on plant establishment at the three-leaves-unfolded stage (GS13) in the first wheat following canola in 2009 and 2012 established on the same site*

* Mean of three row spacings

TABLE 1 Plant establishment at the one-leaf-unfolded stage (GS11) and the three-leaves-unfolded stage (GS13) 26 and 40 days after sowing

Row spacing (cm)	Drill opener Plant establishment (plants/m²)					
	12 June 2012			26 June 2012		
	Disc	Tine	Mean	Disc	Tine	Mean
22.5	183	186	185	219	222	221
30	128	141	135	156	161	158
37.5	120	103	112	133	129	131
Mean	144	144		169	171	
LSD [row spacing]	11			14		
LSD [drill opener]	9			12		
LSD [opener x row]	15			20		
Interactions — drill opener x row spacing	*			ns		

* Significant interaction between drill opener and row spacing

At the one-leaf-stage (GS11), there was a significant interaction between row spacing and drill opener, indicating the tine opener had significantly lower plant establishment than the disc at the 37.5cm spacing. The disc did not reduce establishment when comparing the 30cm and 37.5cm row spacings (see Figure 3).

There was no significant interaction (P<0.05) between row spacing and drill opener at the three-leaves-unfolded stage (GS13), with little difference in establishment as a result of opener type.

Dry matter production

i) Row spacing

Dry matter (DM) production was significantly higher at the 22.5cm spacing than the 30cm spacing, which in turn was significantly higher than the 37.5cm spacing until the harvest assessment (GS99). When DM was assessed at harvest, the narrow row spacing (22.5cm) had produced significantly more DM than the widest row spacing (37.5cm), however neither treatment was significantly different to the 30cm row spacing (see Figure 4). This trend is similar to that seen in the first wheat after canola at this site in 2009 when the 22.5cm row spacing produced significantly more DM than the 37.5cm throughout the growing season.

During 2009, the 30cm row spacing fell non-significantly between the narrow and widest row until harvest.

ii) Drill opener

There were no significant differences generated in DM production during 2012 as a result of drill opener type (see Figure 5). This is different to 2009 when the disc opener produced significantly more DM throughout the growing season than the tine opener.

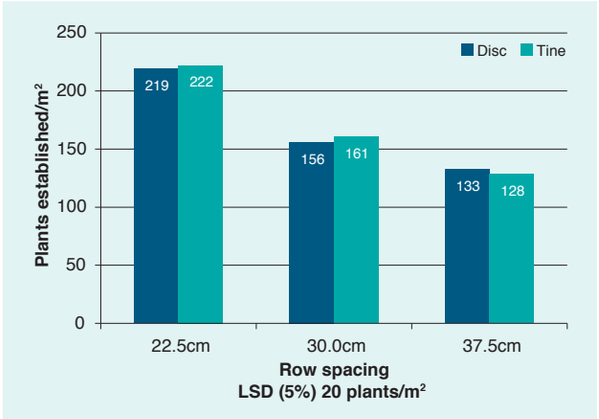

FIGURE 3 Influence of row spacing and drill opener method on plant establishment, at the three-leaves-unfolded stage (GS13)

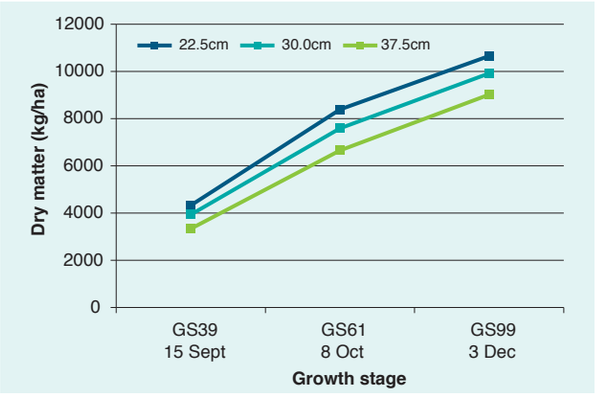

FIGURE 4 Influence of row spacing on dry matter production*
* Mean of both drill openers (15 September – 3 December 2012)

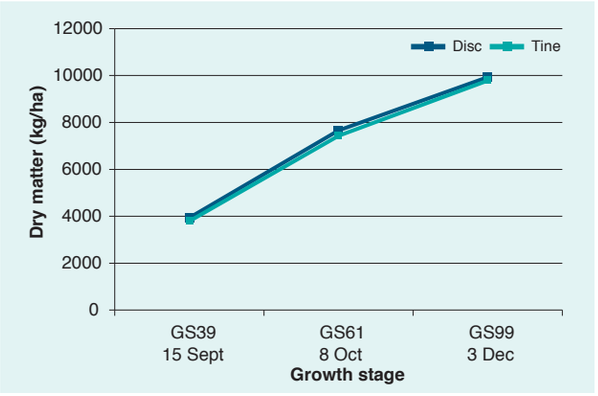

FIGURE 5 Influence of drill opener on dry matter production*
* Mean of three row spacings (15 September – 3 December 2012)

There was no significant interaction between the effect of row spacing and drill opener on DM production at harvest (see Figure 6) or throughout the season.

Crop structure

At the 22.5cm row spacing there were significantly more plants, tillers and heads/m^2 produced than with the crops established at 30cm row spacing.

The 37.5cm row spacing produced significantly fewer plants and tillers/m^2 than the 30cm spacing. However, due to the lower tiller mortality, the difference in heads/m^2 was not significant between the two wider row spacings (see Figure 7).

The wider row spacing produced more tillers/plant by the start of stem elongation (the 22.5cm spacing produced 2.66 tillers/plant compared with 2.93 tillers/plant for 30cm spacing and 3.04 tillers/plant for the 37.5cm spacing). However, the narrow row spacing produced more tillers per unit area, but suffered higher tiller mortality between the start of stem elongation and maturity (about 25% at 22.5cm row spacing and just less than 10% at 37.5cm).

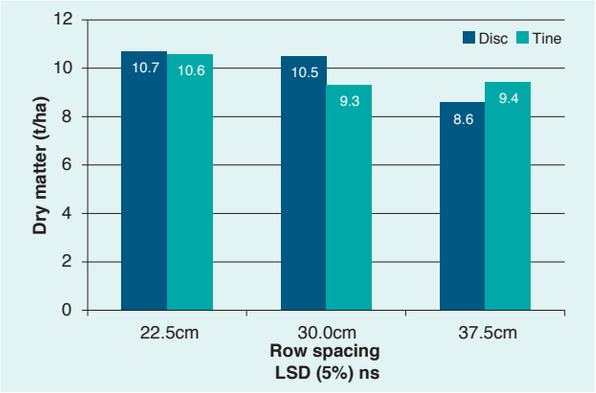

FIGURE 6 Influence of row spacing and drill opener on dry matter production at harvest

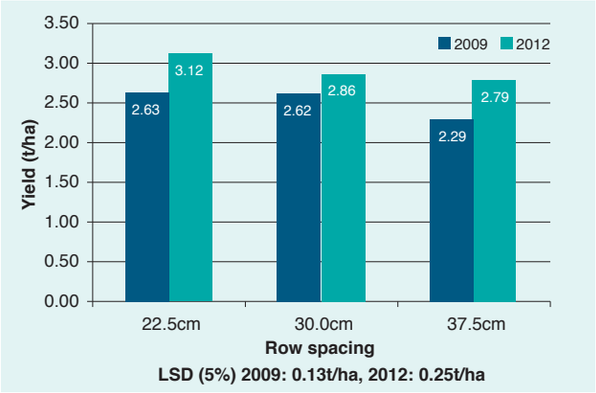

FIGURE 8 Influence of row spacing on yield*

* Mean of both drill openers

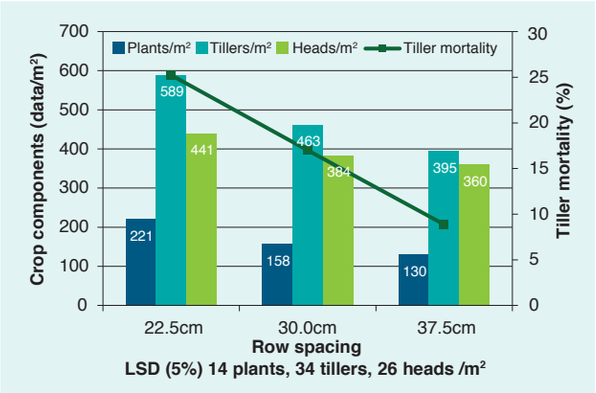

FIGURE 7 Influence of row spacing on crop structure*

* Mean of both drill openers

Yield

i) Yield

The trial had an average yield of 2.92t/ha, which was 0.38t/ha more than the first wheat crop following canola grown on the site during 2009. During 2009, the crop had a growing season rainfall (GSR) of 234mm with little or no stored soil moisture (compared with 196mm GSR during 2012 with 85mm stored soil moisture).

During 2009, with less available soil moisture and lower yields, there was no significant yield difference between the 22.5cm and 30cm row spacings. However, during 2012, with an average yield of about 3t/ha, there was a significant advantage to the narrowest row spacing (see Figure 8).

During 2012, there was a yield penalty of 9% associated with moving from the 22.5cm spacing to the 30cm spacing. There was no significant yield difference between the 30cm and 37.5cm spacings.

The reduction in yield caused by widening row spacing from 22.5cm to 37.5cm was about 11% during 2012. In the first wheat trial sown at the same time in the same paddock in 2009, there was no yield penalty from increasing from 22.5cm to 30cm, but a 13% yield reduction from increasing row spacing from 30cm to 37.5cm.

There was no yield difference generated in the trial as a result of the drill opener used in 2012 (see Figure 9). This result is contrary to the results recorded at the same site in 2009 when the disc opener produced significantly more DM throughout the season and had significantly higher yields.

There was no significant interaction between row spacing and drill opener on the yields obtained in the trial (see Figure 10).

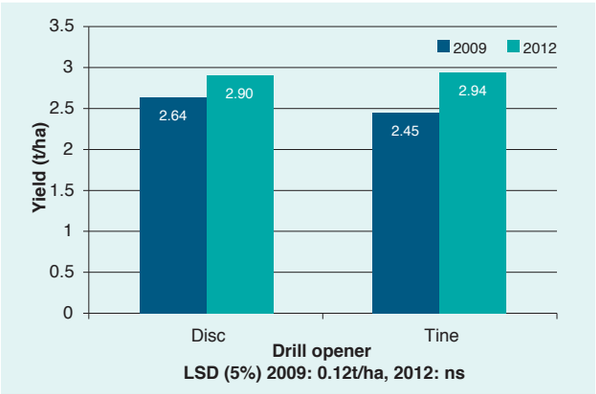

FIGURE 9 Influence of drill opener on yield*

* Mean of three row spacings

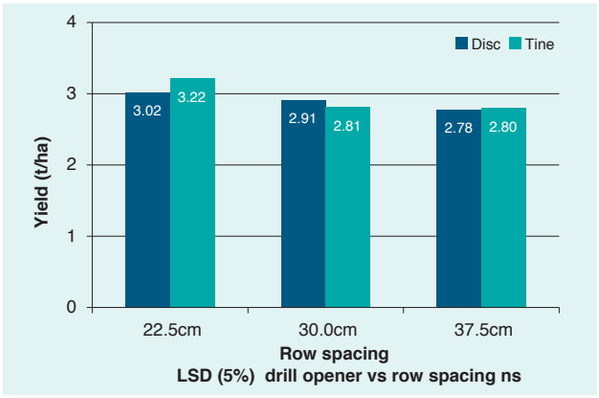

FIGURE 10 Influence of row spacing and drill opener on yield

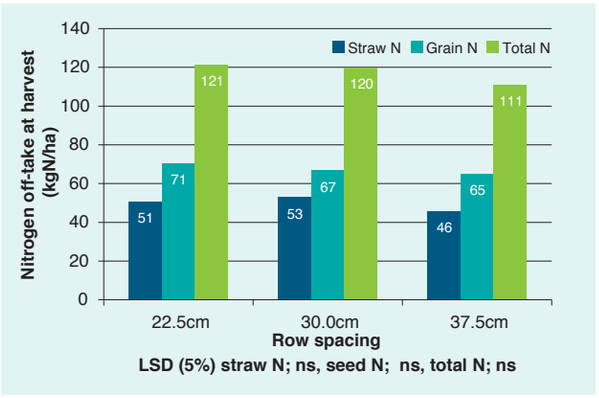

FIGURE 11 Influence of row spacing on nitrogen off-take at harvest*

* Mean of both drill openers

ii) Protein content and grain quality

There were no significant differences in grain protein content, thousand seed weight, test weight or screenings generated in the trial as a result of row spacing or drill opener.

iii) Nitrogen off-take

Row spacing did not significantly influence nitrogen off-take (see Figure 11). However, the type of drill opener used caused a significant (p 0.0155) difference in nitrogen off-take, with more nitrogen removed in the straw of the tine opener treatment — a difference that carried through to a greater overall total nitrogen off-take (data not shown).

Observations and comments

It was estimated that the narrow row spacing produced the best overall WUE (see Table 2). Unlike wheat-on-wheat trials in this research project, the differences in harvest index (HI) were relatively small (28.8–30.9%), indicating that significantly higher biomass at harvest translated to significantly higher grain yields.

All other trends in WUE were similar to those observed in previous seasons (i.e. there is estimated to be more unproductive water in the wider row spacing, however with improved efficiency of water use by the plant which is then converted into grain). This is measured and reported as transpiration efficiency (TE).

TABLE 2 Biomass at harvest, yield, harvest index (HI), water use efficiency (WUE), transpiration, evaporation/drainage and transpiration efficiency (TE)*

Row spacing (cm)	Biomass (kg/ha)	Yield (kg/ha)	HI (%)	WUE[1] (kg/mm)	Transpiration[2] (mm)	Unproductive water[3] (mm)	TE[4] (kg/mm)
22.5	10651	3118	29.3	11.1	194	87	16.1
30	9914	2860	28.8	10.2	180	100	15.9
37.5	9010	2788	30.9	9.9	164	117	17.0

[1] Based on 196mm of GSR (April – October) + 35% fallow efficiency (85mm) for January – March rainfall (total GSR + stored = 281mm) with no soil evaporation term included and assuming no drainage in periods of excessive rainfall.
[2] Transpiration through the plant based on a maximum 55kg harvest biomass/ha.mm transpired.
[3] Unproductive water (evaporation, drainage and water left unused at harvest) is the difference between transpiration through the plant and GSR (mm) + stored water at sowing.
[4] Transpiration efficiency based on kg/ha grain produced per mm of water transpired through the plant.
* Mean of both openers

Sponsors

This trial was carried out as part of the Riverine Plains Inc GRDC-funded project *Improved WUE in no-till cropping and stubble retention systems in spatially and temporally variable conditions in the Riverine Plains* (RP100007).

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