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

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Key points

- Canola trials during 2012 had high plant populations, which may have created atypical crop canopy structures in relation to different row spacings.
- In four canola datasets generated from 2009 – 2012 at Coreen, New South Wales and Bungeet, Victoria the influence of row spacing on yield has been inconsistent.
- During 2012, the narrow row spacing (22.5cm) produced higher yields and a higher harvest index (HI) than wider row spacing, however this has not been the case in previous years.
- In the lowest-yielding year, 2009 (1.5t/ha average yield), the optimum row spacing was 30cm, which was significantly higher yielding than narrower (22.5cm) and wider (37.5cm) row spacings.
- In two datasets, the 30cm spacing yielded significantly lower than the narrow (22.5cm) and wide (37.5cm) row spacings.
- The disc opener produced higher yields than the tine opener in all four datasets, the advantage of the disc opener only being significant in 2012 (Bungeet) and 2009 (Coreen).
- During 2012, oil content in the Coreen trial was not significantly affected by row spacing or drill opener.

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: Clay loam
- pH (H_2O): 6.0 (2011)
- pH ($CaCl_2$): 4.9 (2011)
- Colwell P: 102mg/kg (2011)
- Deep soil nitrogen: 57kg/ha (2011)

Sowing information:
- Variety: Crusher (TT)
- Sowing date: 16 May 2012
- Fertiliser: 170kg/ha SuPerfect
- 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 — wheat
- 2010 — wheat
- 2009 — canola

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 canola established with different drill openers at a range of row spacings following two years of wheat under full stubble retention.

Method

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

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

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

Results

Crop establishment

Due to an error in sowing rate calculations, trial plots were established at a much higher sowing rate than farm practice of 2–4kg/ha. As a result, establishment counts were exceptionally high for canola. Despite this, the establishment still followed some of the trends seen in previous canola trials established as part of the four-year trial program.

The consistent trends include the reduction in plant population as row spacing increases.

In all of the four time replicates of canola in the rotation, the establishment at the 37.5cm row spacing has produced significantly fewer plants than the 22.5cm spacing at the two-true-leaves unfolded stage (see Figure 1). The 2012 results are the first where the tine opener has significantly increased establishment compared with the disc opener; this occurred at both the Bungeet and Coreen trial sites in 2012 (see Figure 2). During 2009, the disc opener produced significantly better establishment results than the tine and in 2011 there was no difference in crop establishment between openers.

In previous trials there has been no difference in the establishment between the 22.5cm and 30cm row spacings, however during 2012 at both Coreen and Bungeet, the 30cm row spacing produced significantly lower plant establishment than the narrowest spacing at 22.5cm.

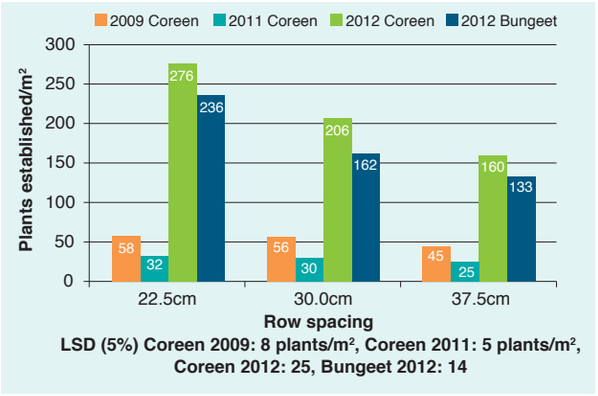

FIGURE 1 Influence of row spacing on canola plant establishment following two years of wheat at Coreen 2009, 2011, 2012 and Bungeet 2012 assessed at two-leaves-unfolded stage*

* Mean of both drill openers

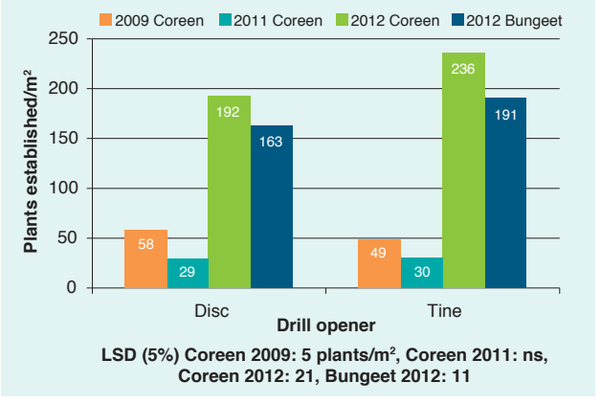

FIGURE 2 Influence of drill opener on canola plant establishment following two years of wheat at Coreen 2009, 2011, 2012 and Bungeet 2012 assessed at the two-leaves-unfolded stage*

* Mean of three row spacings

TABLE 1 Canola plant establishment at two-leaves-unfolded growth stage assessed 37 days after sowing.

Row spacing (cm)	Drill opener Plant establishment (plants/m²)		
	Disc	Tine	Mean
22.5	248	304	276
30.0	191	222	206
37.5	139	181	160
Mean	**192**	**236**	
LSD [row spacing]	25		
LSD [drill opener]	21		
LSD [disc vs tine]	36		
Interactions—drill opener x row spacing	ns		

Dry matter production

i) Row spacing

Differences in dry matter (DM) production due to crop row spacing were evident in the green bud (LSD 116kg DM/ha) and pod set (LSD 459kg DM/ha) assessments only. At these assessment timings, the 22.5cm row spacing had produced significantly more DM than both the 30cm and 37.5cm row spacings, between which there was no difference (see Figure 3).

Row spacing had less impact in this trial than in the other three trials run in the same rotation position. It is unclear how much this result is influenced by the exceptionally high sowing rates.

ii) Drill opener

There were no significant differences in DM production as a result of drill opener until the pod set assessment when the disc opener recorded significantly more DM than the tine (p = 0.008). At the harvest assessment, the significant DM difference was maintained (p = 0.0167) (see Figure 4).

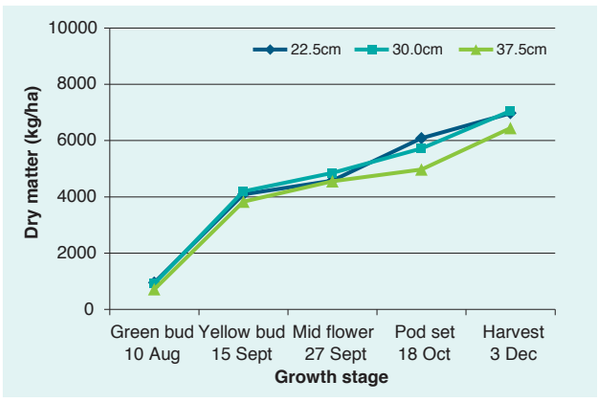

FIGURE 3 Influence of row spacing on dry matter production*
* Mean of both drill openers (4 September – 5 December 2012)

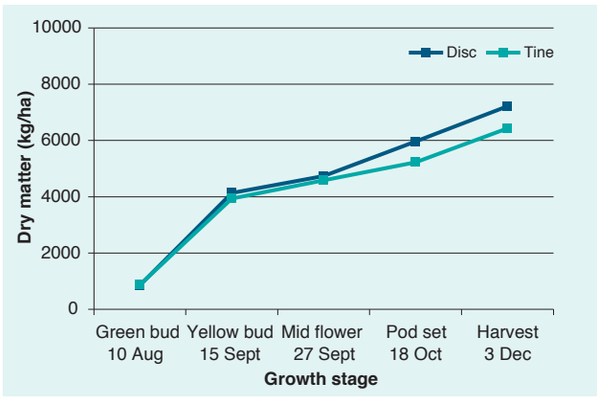

FIGURE 4 Influence of drill opener on dry matter production*
* Mean of three row spacings (10 August – 3 December 2012)

The higher DM produced with the disc opener from mid-flowering onwards was potentially linked to the relatively lower plant populations (192 plants/m^2 vs 236 plants/m^2) and better plant spacing within the row.

Across the four data sets generated from canola as part of this project, the disc opener has consistently produced more DM content than the tine opener (though this has not always been statistically significant). Initially in all data sets, there has been little difference in DM production until mid-flower/pod set where the disc opener treatment shows higher levels of DM production (see Figure 5).

There was no significant interaction between drill opener and row spacing in the DM at harvest assessment (see Figure 6).

Yield

i) Yield

Harvest data from Coreen during 2012 showed a significant yield advantage to the narrow row spacing (p = <0.001), with no yield difference between the 30cm and 37.5cm spacings.

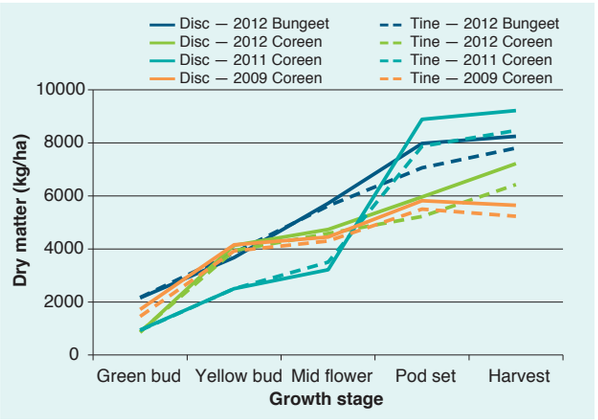

FIGURE 5 Influence of drill opener on dry matter production in canola at Coreen 2009, 2011, 2012 and Bungeet 2012*
* Mean of three row spacings

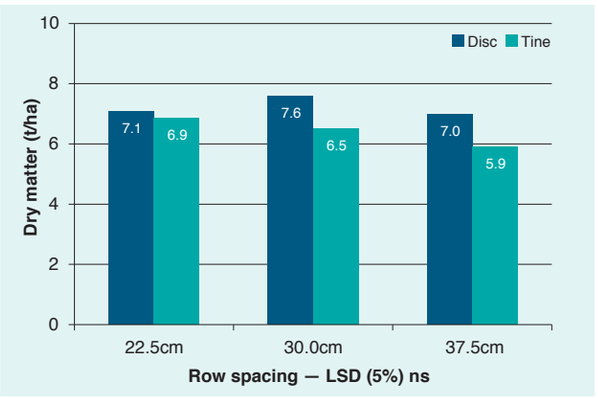

FIGURE 6 Influence of row spacing and drill opener on dry matter production at harvest*
* Mean of both drill openers

Trial yields across the four canola data sets run at Coreen in NSW and Bungeet in Victoria from 2009–2012 have ranged from 1.59–2.59 t/ha. Differences generated as a result of row spacing have been inconsistent. The canola trial at Bungeet during 2012 and at Coreen during 2011, produced similar significant results as a result of row spacing, with the 30cm row spacing being significantly lower yielding than both the 22.5cm and 37.5cm row spacings, between which there was no difference (see Figure 7). During 2009, the lowest yielding dataset (which had the lowest available levels of soil moisture) showed the reverse, with a yield advantage to the 30cm spacing over the narrower and wider row spacings.

Note: Overall, the excessively high plant populations established in two of these four datasets may have adversely influenced the effect of row spacing, though yields did not appear to be unduly compromised.

The disc opener produced higher yields than the tine opener in all four datasets, the advantage of the disc opener being significant only during 2012 (Bungeet) and 2009 (Coreen) (see Figure 8).

There was no significant interaction between row spacing and drill opener on the canola yields obtained in the 2012 trial at Coreen (see Figure 9).

ii) Oil content

Oil content was not significantly affected by row spacing or drill opener in this trial. Interestingly, the oil contents at the Coreen site were lower than those recorded at the Bungeet trial site; the Coreen site had an average oil content of 39.0% compared with 43.9% at the Bungeet site.

iii) Nitrogen off-take

Differences in the nitrogen off-take as a result of row spacing were significant in the seed component, but not in the straw component (p=0.0529) (see Figure 10).

The disc opener generated significantly greater total nitrogen off-take than the tine opener when assessed at harvest (data not presented). This difference in total nitrogen off-take stemmed from the significantly higher nitrogen off-take in the straw when the disc opener was used.

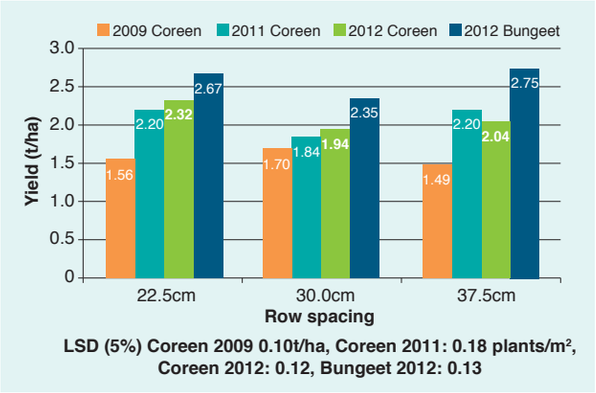

FIGURE 7 Influence of row spacing on canola yield at Coreen 2009, 2011, 2012 and Bungeet 2012*

* Mean of both drill openers

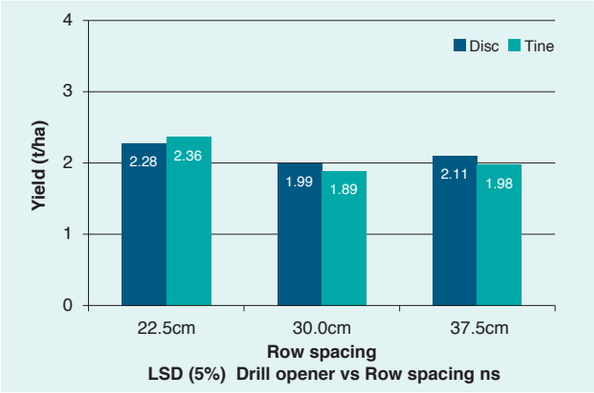

FIGURE 9 Influence of row spacing and drill opener on canola yield at Coreen 2012

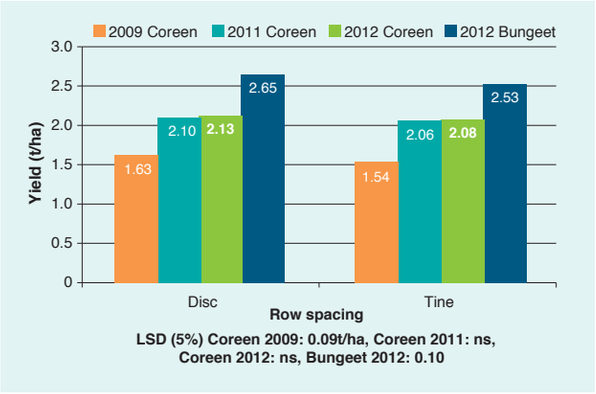

FIGURE 8 Influence of drill opener on canola yield at Coreen 2009, 2011, 2012 and Bungeet 2012*

* Mean of three row spacings

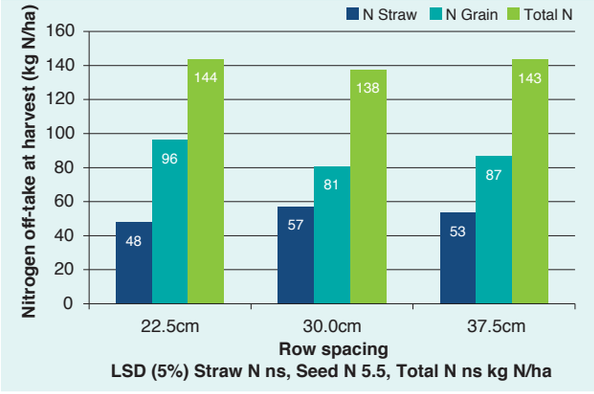

FIGURE 10 Influence of row spacing on nitrogen off-take at harvest*

* Mean of both drill openers

Observations and comments

It was estimated that the narrow row spacing produced the best overall WUE (see Table 2), though it is unclear why the harvest index at 30cm was lower than 22.5cm and 37.5cm spacings.

It is important to emphasise that the 2012 results may have been abnormally influenced by the high plant populations, driven by the excessively high sowing rate.

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).

Thanks go to farmer co-operators, the Hanrahan family and John Seidel as trial manager.

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	6972	2321	33.3	8.3	139	141	16.6
30	7051	1943	27.6	6.9	141	139	13.8
37.5	6442	2041	31.7	7.3	129	152	15.8

[1] Based on 196mm of GSR (April – October) + 35% fallow efficiency (84mm) 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 50kg 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

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