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

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Key points

- First wheat following the break crop of canola yielded 3.7t/ha with 301mm growing season rainfall (GSR). This was 1.4t/ha less than the first wheat crop following faba beans during 2010, which had a GSR of 537mm.
- Yields of first wheat following canola were significantly higher at the narrow row spacing compared with the 30cm and 37.5cm spacings, between which there was no significant difference. Moving from a 22cm spacing to 30cm and 37.5cm spacings reduced yield by 12% and 14% respectively.
- Establishment at the 22.5cm row spacing was significantly higher than establishment in the 30cm rows, which in turn was significantly superior to the 37.5cm spacing.
- Dry matter (DM) production was significantly higher at the 22.5cm and 30cm row spacings than at the 37.5cm spacing.
- Although the type of drill opener did not significantly effect establishment or DM production, the tine opener was significantly higher yielding than the disc opener (by 0.39t/ha).

Location: Bungeet, VIC

Rainfall:
- **Annual:** 629mm
- **GSR:** 301mm (April–Oct)
- **Stored moisture:** 115mm

Soil:
- **Type:** Loam over clay, Wattville No. 205
- **pH (H_2O):** 6.0
- **pH ($CaCl_2$):** 5.5
- **Colwell P:** 65mg/kg
- **Deep soil nitrogen:** 55kg/ha

Sowing information:
- **Variety:** Young
- **Sowing date:** 1 June 2011
- **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:
- **2010** — canola
- **2009** — wheat
- **2008** — triticale (farm cereal)

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 a canola break.

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 canola as part of a five-year cropping rotation trial.

The 2011 trial was the third successive crop superimposed on the original no-till stubble retention trial site.

- 2008 — wheat (farm crop)
- 2009 — wheat (first trial year)
- 2010 — canola (second trial year)
- **2011 — wheat**
- 2012 — cereal

Crop stubble from the 2010 canola crop was chopped and spread at right angles to the direction of plots.

Results

Crop establishment

The narrow (22.5cm) row spacing resulted in significantly more wheat plants establishing into canola stubble than the wheat sown at the 30cm spacing. The 30cm spacing had significantly better establishment than the 37.5cm spacing at both 25 and 42 days after sowing. This was the same as that observed during the first wheat trial following faba beans established in the same paddock the previous season (see Figure 1).

Drill opener did not significantly affect establishment at either of the two assessment times (see Figure 2). The same result was observed during the 2010 first-year wheat crop assessed at the three-leaves-unfolded stage (GS13).

Although there were significant differences in establishment between the row spacings, there was no significant interaction between row spacing and drill opener on plant establishment (see Figure 3).

TABLE 1 Plant establishment at first-leaf-unfolded stage (GS11) and three-leaves-unfolded stage (GS13) assessed 25 and 42 days after sowing

Row spacing	Drill opener[1] Plant establishment (plants/m²)					
	26 June 2011			13 July 2011		
	Disc	Tine	Mean	Disc	Tine	Mean
22.5cm	130	135	**133**	151	152	**151**
30.0cm	90	85	**87**	105	101	**103**
37.5cm	71	73	**72**	78	81	**80**
Mean	**97**	**98**		**111**	**111**	
LSD [row spacing]	8			7		
LSD [drill opener]	7			6		
LSD [disc[4]] [tine[8]]	13	12		12	10	
LSD [disc[4] vs tine[4]]	10			8		
Interactions — Drill opener x row spacing				ns		

[1] Tine treatments had eight replicates compared with four for the disc treatment

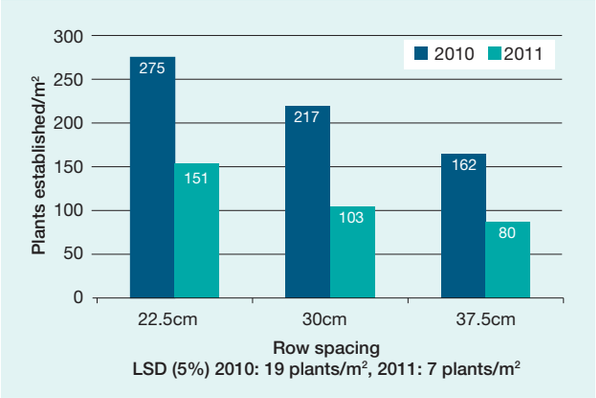

FIGURE 1 Influence of row spacing on plant establishment in first-year wheat crops grown during 2010 and 2011, assessed at the three-leaves-unfolded stage (GS13)*

* Mean of both drill openers

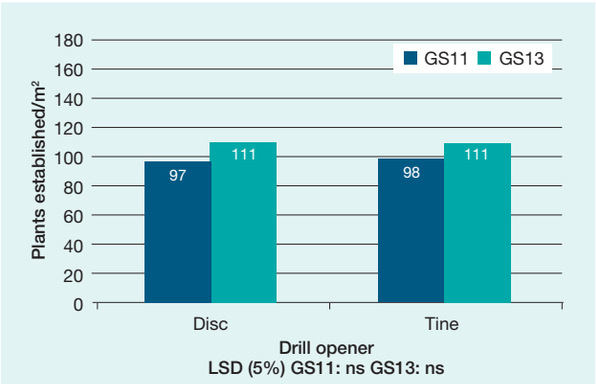

FIGURE 2 Influence of drill opener on plant establishment at the one- and three-leaves-unfolded stages (GS11 and GS13)*

* Mean of three row spacings

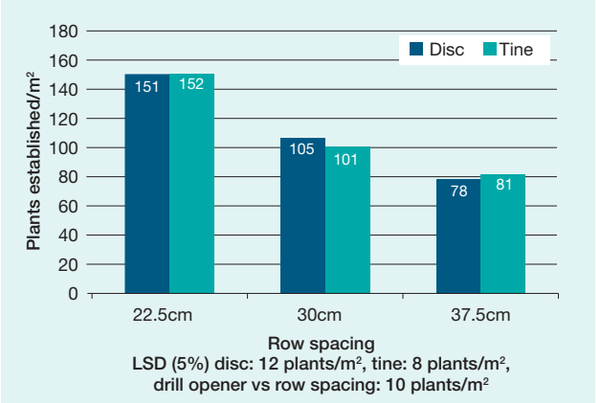

FIGURE 3 Influence of row spacing and drill opener method on plant establishment at the three-leaves-unfolded stage (GS13)

Dry matter production

i) Row spacing

Row spacing caused significant differences in dry matter (DM) production throughout the growing season in first-year wheat established following canola. Assessments done at first node (GS31) and flag leaf emergence (GS39) showed significantly more DM at the 22.5cm row spacing than the 30cm spacing, which in turn had significantly more DM than the widest row spacing of 37.5cm. However, by the start of flowering (GS61) the difference in DM production between the 30cm and 37.5cm row spacings was no longer significant. At harvest, the DM production of the 22.5cm and 30cm spacings was significantly greater than that of the widest row spacing.

ii) Drill opener

There were no significant differences in DM production throughout the course of the season as a result of drill opener (mean of three spacings) (see Figure 5).

However there was a significant interaction between drill opener and row spacing on harvest DM production, which was significantly greater with the tine at the 37.5cm row spacing. While the disc opener produced more DM than the tine at the narrowest spacing, this was not statistically significant (see Figure 6). There were no significant differences in DM production between openers at the 30cm spacing.

Crop structure

The 22.5cm row spacing had significantly more tillers and heads/m^2 than the 30cm spacing, which in turn had significantly more tillers and heads/m^2 than the 37.5cm spacing. This correlated with the DM production figures. Crop established at the widest row spacing produced more tillers per plant (3.9 tillers/plant) than the narrowest row spacing (3.4 tillers /plant). The average level of tiller mortality (tillers present at stem elongation that do not produce a viable head) in the trial was 35% and the narrowest row spacing had the highest mortality at 39%. The widest row spacing (37.5cm) produced almost one more head per plant than the narrowest spacing, although absolute head numbers were higher at the narrower row spacing (see Figure 7).

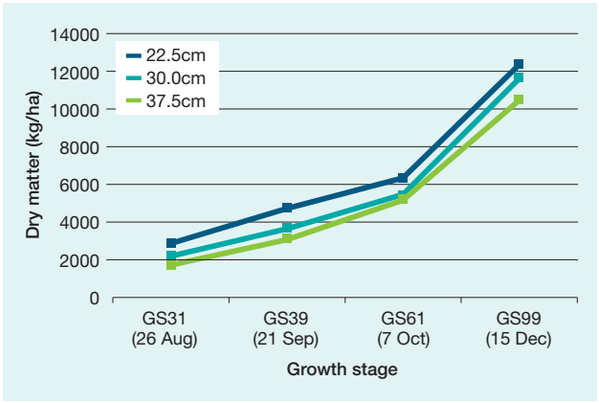

FIGURE 4 Influence of row spacing on dry matter production*
*Mean of both drill openers (26 August – 15 December 2011)

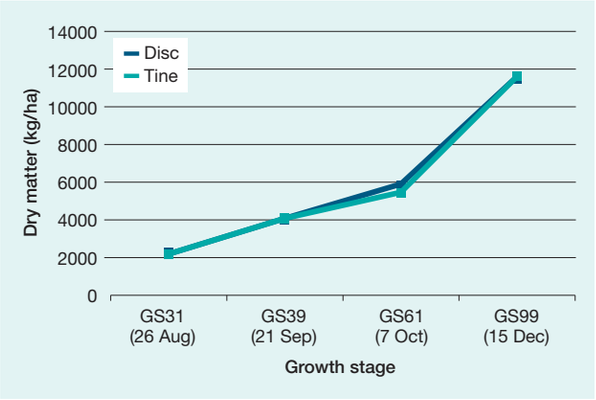

FIGURE 5 Influence of drill opener on dry matter production*
* Mean of three row spacings (26 August – 15 December 2011)

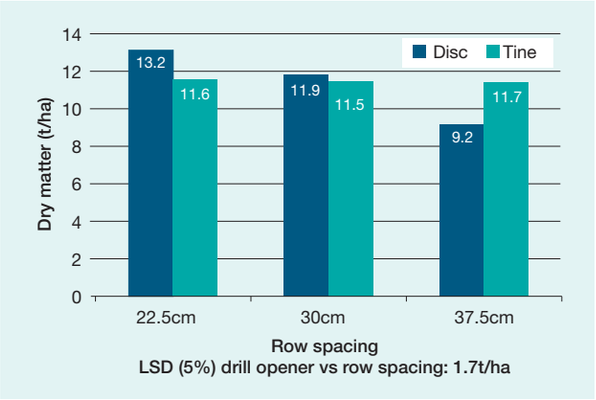

FIGURE 6 Influence of row spacing and drill opener on dry matter production at harvest

Yield

i) Yield

First wheat following canola yielded on average 3.7t/ha, compared with first wheat after faba beans grown in the same paddock during 2010, which yielded an average of 5.07t/ha. There was an additional 236mm of growing season rainfall (GSR) during 2010 than 2011 and, as a result, stored soil moisture during 2011 was already at 115mm at the start of the growing season.

Both the 2010 and 2011 trial years showed the same significant yield differences at harvest whereby the 22.5cm row spacing was significantly higher yielding

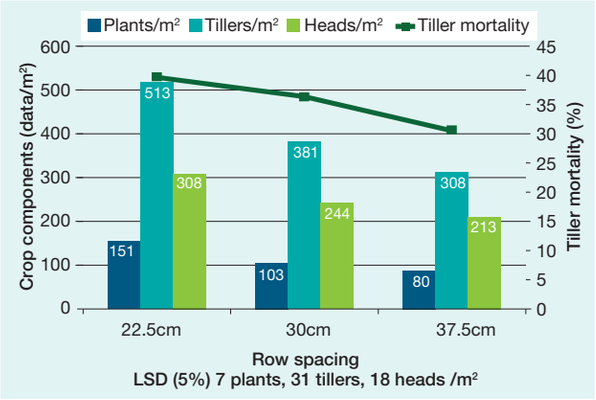

FIGURE 7 Influence of row spacing on crop structure*
* Mean of both drill openers

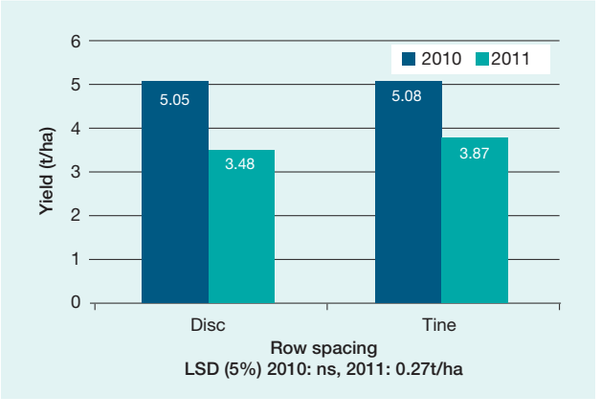

FIGURE 9 Influence of drill opener on first-year wheat yields after the break*
* Mean of three row spacings

than the 30cm and 37.5cm row spacing (between which there was no significant yield difference) (see Figure 8).

In terms of average yield (mean of the three spacings) the tine opener yielded significantly more (0.39t/ha) than the disc opener, despite no differences in initial crop establishment. The 2010 harvest data also showed a small advantage to the tine opener although this was not statistically significant (see Figure 9).

There was no significant interaction between row spacing and drill opener on grain yields in this trial.

Both row spacing and drill opener affected grain yield in this trial. The tine opener was significantly higher yielding than the disc at the narrowest row spacing. While there was a trend for the tine opener to out-yield the disc opener at the 30cm and 37.5cm spacings, this was not statistically significant (see Figure 10).

The yield of the disc opener was significantly higher at the 22.5cm spacing (3.78 t/ha) than at the 37.5cm spacing (3.26 t/ha).

The tine and disc openers at the narrowest row spacing yielded significantly more than the tine and disc openers at the 37.5cm spacing.

ii) Protein content

There were no significant differences generated in protein as a result of row spacing or opener.

iii) Nitrogen off-take

In this first wheat rotation position the total nitrogen off-take of the tine opener (107kg/ha) was significantly more than the disc opener at 98kg/ha. The amount of nitrogen removed in the straw was similar across all treatments.

Narrower row spacings had greater amounts of nitrogen removed in the grain, which was significantly more than that of the two wider row spacings (see Figure 12). The drill opener also had a significant impact, with the tine opener plots removing an additional 5.6kg/ha than the disc opener.

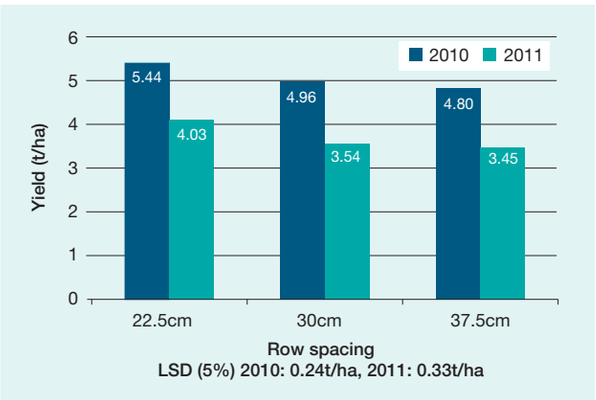

FIGURE 8 Influence of row spacing on first-year wheat yields after faba beans during 2010 and canola during 2011*
* Mean of both drill openers

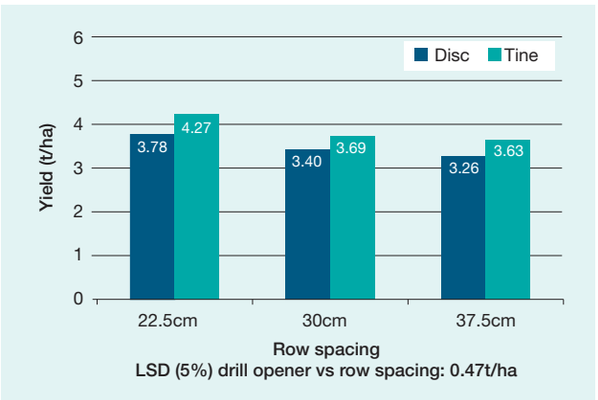

FIGURE 10 Influence of row spacing and drill opener on yield

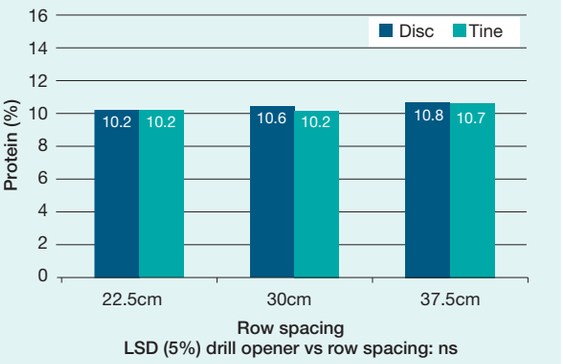

FIGURE 11 Influence of row spacing and drill opener on protein

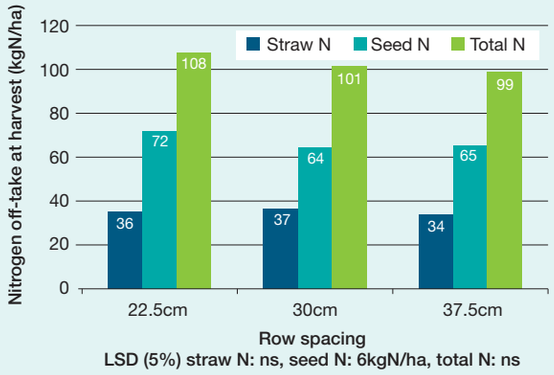

FIGURE 12 Influence of row spacing on nitrogen off-take*
* Mean of both drill openers

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	12378	4026	32.5	9.7	225	191	17.9
30	11680	3545	30.4	8.5	212	203	16.7
37.5	10474	3453	33.0	8.3	190	225	18.1

[1] Based on 301mm of GSR (April–October) + 35% fallow efficiency (115mm) for January–March rainfall (total GSR + stored = 416mm) 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

Water use efficiency

The narrow row spacing produced the highest yields and had the highest WUE at 9.7kg of grain produced for every millimetre of water available to the crop through the season. The amount of water available was calculated as GSR plus stored moisture at sowing (calculated as 35% efficiency of the summer fallow rainfall), which totalled 416mm.

The narrowest row spacing produced the largest biomass at harvest and therefore lost the most water through transpiration from the canopy. It was estimated that for every millimetre of water transpired through the canopy at the 22.5cm row spacing there was 17.9kg/ha of grain produced. The 37.5cm row spacing, which produced the smallest canopy biomass at harvest, had a slightly higher transpiration efficiency of 18.1mm, however more water was estimated to be unproductive at this spacing compared with the 22.5cm row spacing (225mm vs 191mm).

SPONSORS

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