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

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Key points

- In second wheat after faba beans, moving from a narrow row spacing of 22.5cm to 30cm and 37.5cm row spacings reduced yield by 4% and 10% respectively. This compares with respective yield reductions of 12% and 14% in the first wheat trial grown in the same paddock at the same time.
- The narrow row spacing (22.5cm) produced greater biomass than the wider row spacing but had a relatively poor harvest index (26%) compared with other row spacings in this trial.
- There was no difference in crop establishment or yield due to drill opener (tine versus disc), however plant establishment was superior with the narrow row compared with the wider spacings tested.
- It was estimated that the narrow row spacing resulted in better water use efficiency than the wider spacings, despite having a lower harvest index.

Location: Bungeet, Vic

Rainfall:
Annual: 629mm
GSR: 301mm (April–Oct)
Stored moisture: Estimated 115mm (estimated at 35% fallow efficiency)

Soil:
Type: Loam over clay, Wattville No. 205
pH (H_2O): 5.9
pH ($CaCl_2$): 5.5
Colwell P: 61mg/kg
Deep soil nitrogen: 64kg/ha

Sowing information:
Variety: Young
Sowing date: 1 June 2011
Sowing rate: 85kg/ha
Fertiliser: 115kg/ha (85+30 with resowing) 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 — wheat
2009 — faba beans (farm crop),
2008 — wheat (farm crop)

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 second wheat crop after the break crop (faba beans).

Method

A replicated experiment was established to test the effect of a range of drill openers and row spacings on the second wheat crop after the break of faba beans as part of a four-year cropping rotation trial. The 2011 trial was the second successive crop superimposed on the original no-till stubble retention trial site.

- 2008 — wheat (farm crop)
- 2009 — faba beans (farm crop)
- 2010 — wheat
- **2011 — wheat**
- 2112 — canola
- 2013 — wheat

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

Row spacing (cm)	Drill opener[1] Plant establishment (plants/m²)					
	26 June 2011			13 July 2011		
	Disc	Tine	Mean	Disc	Tine	Mean
22.5	129	128	**128**	155	148	**152**
30.0	94	91	**92**	114	105	**109**
37.5	73	73	**73**	81	91	**86**
Mean	**99**	**97**		**116**	**114**	
LSD [row spacing]	9			8		
LSD [drill opener]	8			7		
LSD [disc[4]] [tine[8]]	15	13		13	11	
LSD [disc[4] vs tine[4]]	11			9		
Interactions — drill opener x row spacing (13 July)				*		

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

Crop stubble from the 2010 wheat crop was chopped and spread at right angles to the direction of the plots. However due to the high stubble load, plots were raked before sowing to reduce the amount of surface trash

Results

Crop establishment

The establishment of this second-year wheat into the stubble of the previous 5t/ha wheat crop resulted in the narrow (22.5cm) row spacing establishing significantly more plants/m² than crops sown at 30cm. The 30cm spacing in turn established significantly more plants/m² than the 37.5cm spacing at 25 and 42 days after sowing. Establishment results from this second-year wheat trial were very similar to those of the replicated first wheat trial sown in the same paddock at the same time (see Figure 1).

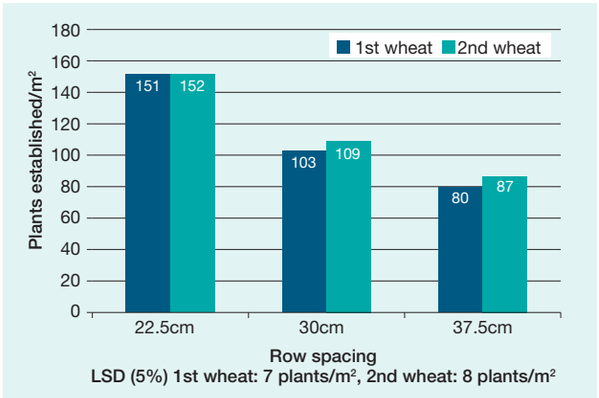

FIGURE 1 Influence of row spacing on plant establishment at the three-leaves-unfolded stage (GS13) in first and second-year wheat established on the same site*
* Mean of both drill openers

The drill opener did not have an impact on crop establishment in either the first or second wheat rotation positions (see Figure 2).

There was a significant (P<0.05) interaction between row spacing and drill opener on 13 July assessment. This was because the narrow row spacing had a higher plant population with the disc seeder, while at the widest row spacing, the tined seeder provided better establishment (see Figure 3). Crop establishment with the disc at the 22.5cm and 30cm row spacings was better than the tine opener, although not significantly.

Dry matter production

i) Row spacing

Dry matter (DM) production was significantly higher at the 22.5cm spacing than it was at the 30cm spacing, which in turn was significantly higher than the 37.5cm spacing until flag leaf emergence (GS39). At the

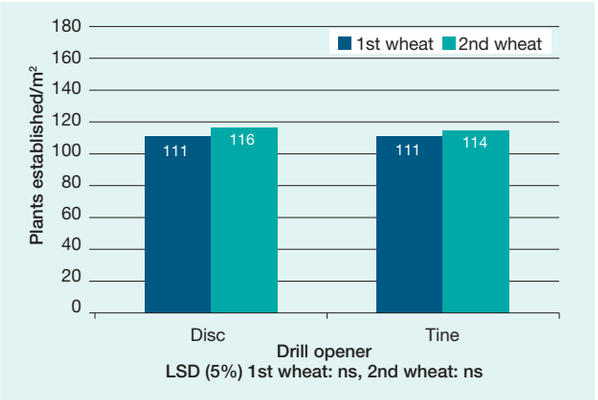

FIGURE 2 Influence of drill opener on plant establishment at the three-leaves-unfolded stage (GS13) in first and second-year wheat established on the same site
* Mean of three row spacings

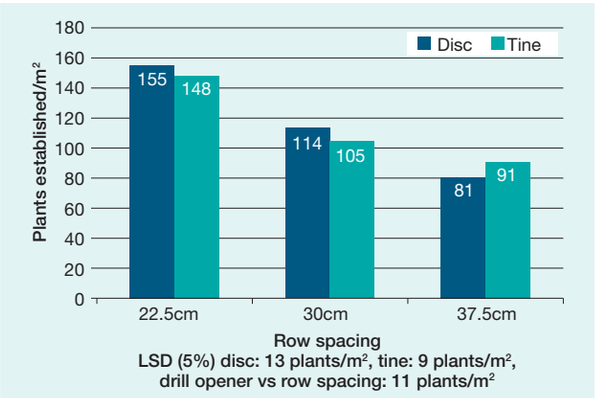

FIGURE 3 Influence of row spacing and drill opener method on plant establishment, at the three-leaves-unfolded stage (GS13)
* Mean of both drill openers

start of flowering (GS61) the narrow row spacing had significantly more DM than the widest row spacing, with the 30cm spacing falling non-significantly between the two. At harvest the difference in DM production between the 30cm and 37.5cm spacing had increased and was again statistically significant (LSD 1175kg DM/ha) (see Figure 4).

ii) *Drill opener*

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

There was however a significant interaction between row spacing and drill opener on DM production at harvest whereby the tine opener produced significantly more DM than the disc at the widest row spacing but not at the narrower spacing (see Figure 6). This trend is similar to that observed in the neighbouring first wheat trial.

Crop structure

With the exception of the large quantity of DM produced at harvest by the narrow row spacing in this second-year wheat trial, canopy composition was similar to that observed in the first wheat trial. At the 22.5cm row spacing there were significantly more tillers/m^2 and heads/m^2 than in the 30cm row crop, which in turn had significantly more tillers/m^2 and heads/m^2 than the 37.5cm row spacing (see Figure 7).

Yield

i) *Yield*

Second-year wheat (wheat on wheat after faba beans) on average produced 0.18t/ha more than the first wheat, the two trials having been established with 64kg and 55kg of deep mineral nitrogen/ha respectively; both trials received 130kg urea/ha during late August.

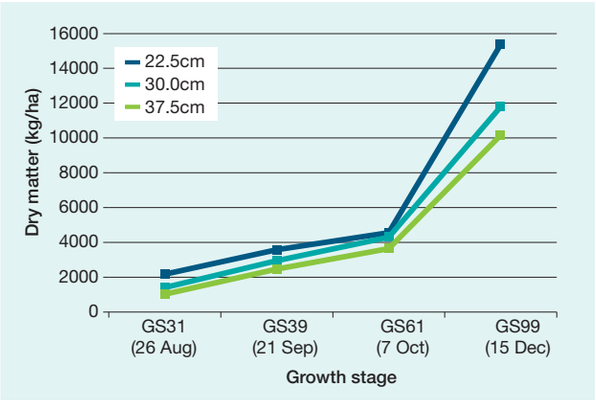

FIGURE 4 Influence of row spacing on dry matter production*
*Mean of both drill openers (26 August – 15 December 2011)

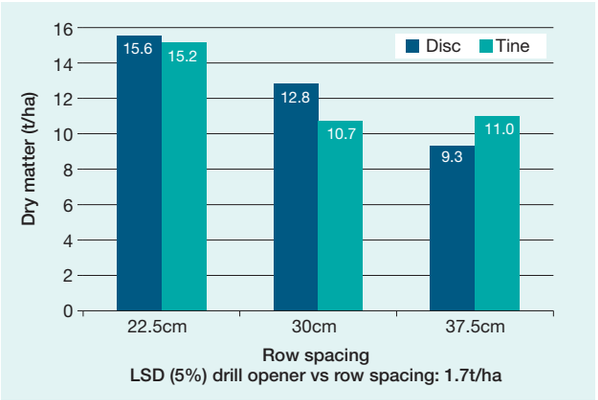

FIGURE 6 Influence of row spacing and drill opener on dry matter production at harvest*
* Mean of both drill openers

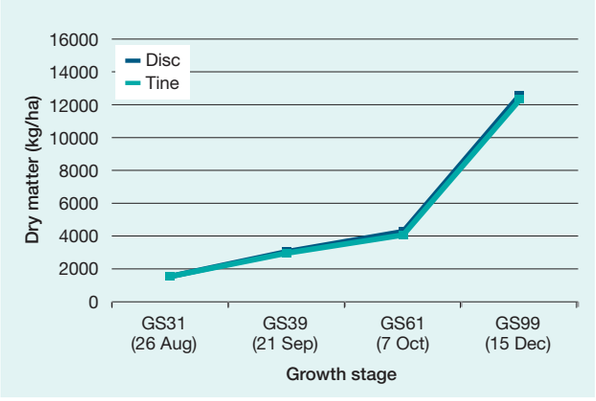

FIGURE 5 Influence of drill opener on dry matter production*
* Mean of three row spacings (26 August – 15 December 2011)

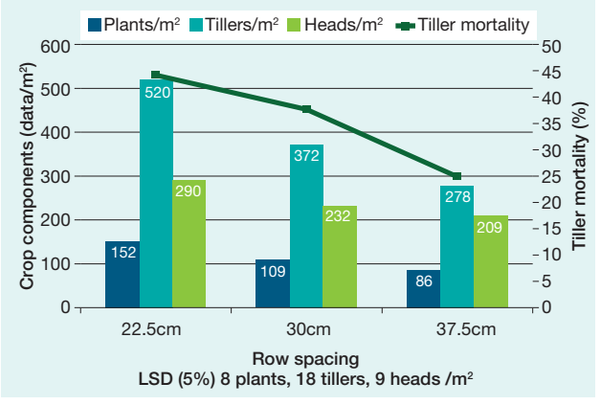

FIGURE 7 Influence of row spacing on crop structure*
* Mean of both drill openers

The narrow row spacing yielded significantly more than that of the widest row spacing (see Figure 8). The 30cm row spacing yield was intermediate and not significantly different to either the narrow or widest row spacings. The reduction in yield as row spacing increased from 22.5cm to 37.5cm was about 10%. This compares to a 14% reduction in yield in the first wheat trial sown at the same time in the same paddock.

There was no difference generated in the trial as a result of drill opener used (see Figure 9). This lack of yield difference due to drill opener type was seen in equivalent second-year wheat trials grown at both the Bungeet and Coreen trial sites.

There was no significant interaction between row spacing and drill opener on the yields obtained in the trial (see Figure 10). There was a non-significant trend for the disc opener to outyield the tine opener at the two narrower row spacings, however at the widest spacing the tine opener was better.

ii) Protein content

There were no significant differences generated in the protein content of the crop as a result of opener or row spacing (see Figure 11). The mean protein content of the second-year wheat crop was 10.2%, which was 0.2% behind that of the first-year wheat crop.

iii) Nitrogen off-take

Total nitrogen off-take was greatest at the narrowest row spacing. The widest row spacing had significantly less nitrogen removed in the grain and total nitrogen off-take than that of the two narrower row spacings. There was no significant difference in the amount of nitrogen removed in the straw. Drill opener had no effect on the nitrogen off-take of the crop.

Observations and comments

It was estimated that the narrowest row spacing produced the best overall WUE (see Table 2) at 9.7kg grain for every millimetre of water available to the crop through the season (growing season rainfall plus 35% efficiency of summer fallow rainfall totalling 416mm). However, the narrow row

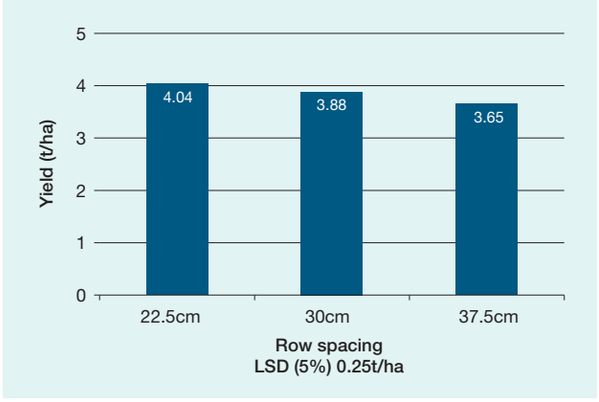

FIGURE 8 Influence of row spacing on yield*
* Mean of both drill openers

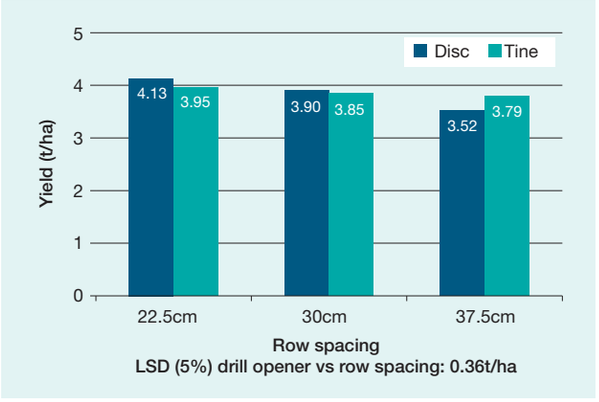

FIGURE 10 Influence of row spacing and drill opener on yield*
* Mean of both drill openers

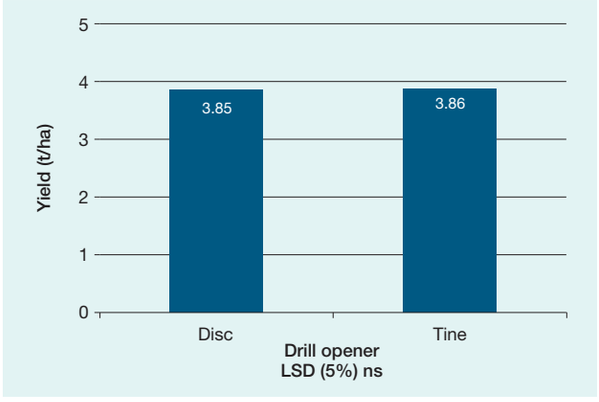

FIGURE 9 Influence of drill opener on yield*
* Mean of three row spacings

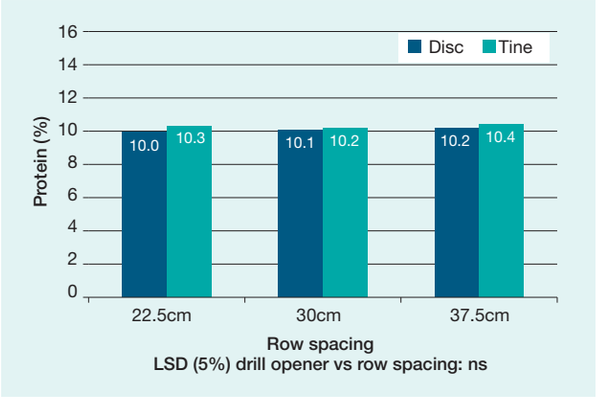

FIGURE 11 Influence of opener and row spacing on protein

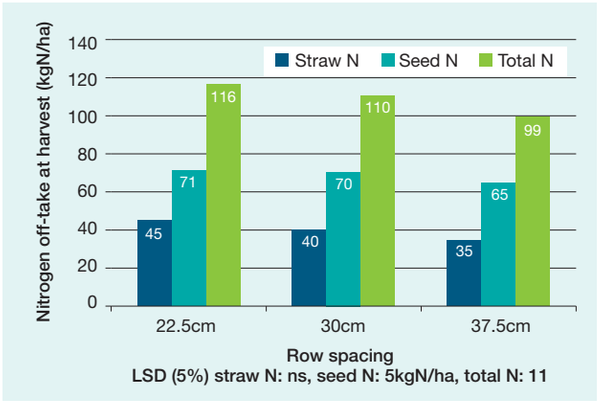

FIGURE 12 Influence of row spacing on nitrogen off-take*
* Mean of both drill openers

spacing produced a lower harvest index (26.3%) than the first wheat trial at the same site (32.5%).

The lower biomass and high harvest index of the wide row spacing meant it had considerably better transpiration efficiency (efficiency of water that passes through the plant being converted to grain) at 19.8kg of grain for every millimetre of water transpired through the crop compared with 14.5kg/mm in the narrow spacing. However it was also estimated that wider row spacing had about 100mm more unproductive water than the narrowest row spacing. This means it either evaporated, was lost through drainage or was still in the soil at harvest but never used. As a consequence, the overall WUE was poorer with the widest row spacing.

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	15376	4040	26.3	9.7	280	136	14.5
30	11795	3878	32.9	9.3	214	201	18.1
37.5	10160	3653	36.0	8.8	185	231	19.8

[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 drill openers

SPONSORS

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