

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

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Key points

- Wheat on wheat (following canola) yielded 4.91t/ha, almost 1t/ha less than the neighbouring first wheat trial after canola (same cultivar, sowing date and inputs), which yielded 5.84t/ha.
- There was no yield drop-off associated with wider row spacings (30cm and 37.5cm) in this wheat-on-wheat situation.
- Results indicate the higher biomass observed with the narrower row spacing did not translate to grain yield.
- There were no significant effects of the drill opener (disc vs tine) on dry matter (DM), crop structure or yield.
- 165–175kg/ha of nitrogen (N) was removed in above-ground biomass (straw and grain) with wheat on wheat.
- Nitrogen off-take in the grain (protein) at harvest was unaffected by row spacing or drill opener, however there was evidence the narrow row spacing removed slightly more nitrogen in the straw due to higher DM.
- Water use efficiency was similar among the treatments, though there was evidence of slightly higher water losses from the soil with the wider row spacing.

Location: Coreen, NSW

Rainfall:
Annual: 835mm
GSR: 570mm (April–mid-November)

Soil:
Type: Clay loam
pH (H_2O): 5.9
pH ($CaCl_2$): 4.9

Sowing information:
Variety: Gladius, wheat
Sowing date: 27 May 2010
Sowing rate: 85kg/ha
Sowing fertiliser: MAP + Intake
Sowing equipment: Janke tine and press wheel. Single disc opener

Row spacing: 22.5cm, 30cm and 37.5cm

Paddock history:
2009 — wheat
2008 — canola

Plot size: 44m x 3m

Replicates: 4 (disc) and 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.

Trial aim

The aim of this trial was to evaluate the performance of different drill openers at a range of row spacings for a second wheat (wheat on wheat) after canola in a no-till rotation. Results for an equivalent trial evaluating first wheat following canola (also run during 2010) can be found on pages 6–10.

Method

A replicated experiment was established to test the effect of a range of drill openers and row spacings in a second wheat crop (wheat on wheat) after canola.

Crop stubble from the previous first wheat crop trial (see *Research for the Riverine Plains 2010* pages 14–17) was chopped and spread at right angles to the direction of plots.

Results

Crop establishment

The establishment of wheat into wheat stubble from the previous crop resulted in the narrow (22.5cm) row spacing giving significantly ($p<0.001$) better establishment than crops sown at 30cm, which in turn were significantly superior to 37.5cm. This result was identical to the neighbouring first wheat trial after canola (see Table 1 and Figure 1).

Disc openers resulted in significantly better establishment ($p<0.02$) than tine openers in this wheat-on-wheat crop (see Figure 2). The results are similar to those observed in the first wheat trial at the same site. While the differences were statistically significant, the actual differences in plants established was small (less than 15 plants/m^2).

The effect of row spacing was similar across both drill openers and there was no significant interaction between these two factors, however the differences between openers was very small at the widest row spacing (see Figure 3).

Dry matter production

i) Row spacing

Second wheat (wheat on wheat) crops established at 22.5cm row spacing produced significantly more DM than both the wider row spacings at the start of stem elongation (GS31). Thereafter, the 22.5cm spacing was only significantly superior to the widest spacing (37.5cm) (see Figure 4). The 30cm row spacing produced significantly more biomass than the 37.5cm spacing, but showed no significant difference for the narrow spacing (22.5cm) from flag leaf emergence onwards.

TABLE 1 Plant establishment at the coleoptile emerging to first-leaf-unfolded stages (GS10–11) and three-leaves-unfolded stage (GS13) assessed 22 and 39 days after sowing

Row spacing (cm)	Drill opener[1] Plant establishment (plants/m^2)					
	18 June 2010			5 July 2010		
	Disc	Tine	Mean	Disc	Tine	Mean
22.5	120	114	**117**	170	147	**158**
30.0	100	91	**96**	133	121	**127**
37.5	77	72	**74**	98	96	**97**
Mean	**99**	**92**		**134**	**121**	
LSD (row spacing)	8			11		
LSD (drill opener)	6			9		
LSD (disc) (tine)	13	9		19	13	
LSD (disc vs tine)	11			16		
Interactions — drill opener x row spacing				ns		

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

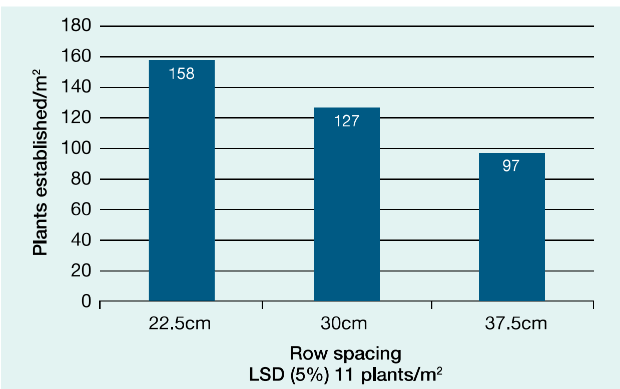

FIGURE 1 Influence of row spacing on crop establishment, at the three-leaves-unfolded stage (GS13) 39 days after sowing

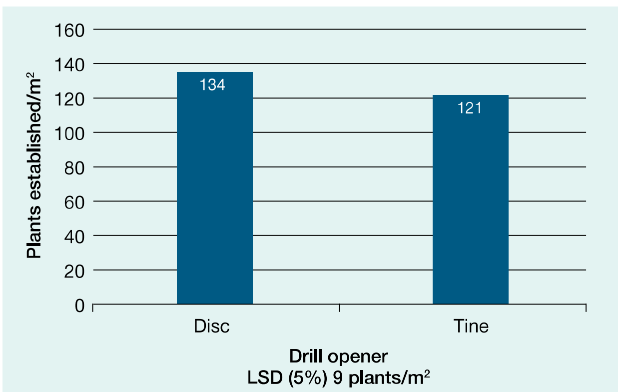

FIGURE 2 Influence of drill opener on crop establishment, at the three-leaves-unfolded stage (GS13) 39 days after sowing

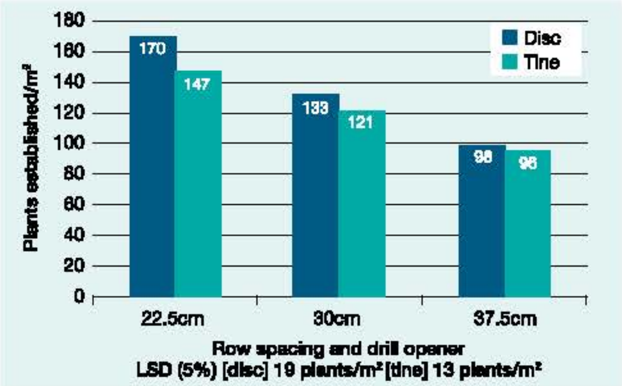

FIGURE 3 Influence of row spacing and drill opener method on crop establishment, at the three-leaves-unfolded stage (GS13) 39 days after sowing

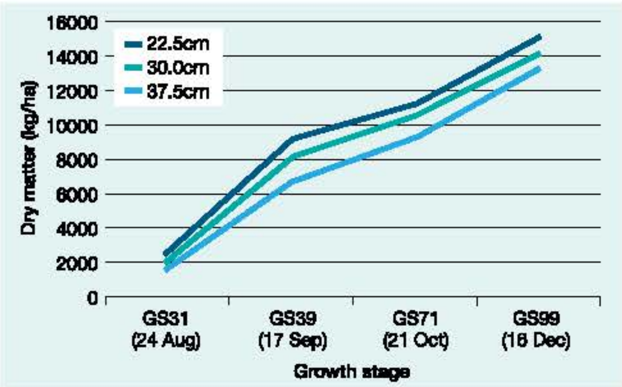

FIGURE 4 Influence of row spacing on dry matter production*
*Mean of both drill openers (24 August–16 December 2010)

ii) Drill openers

At the start of stem elongation (GS31), the disc-established plots had produced more DM than the tine-established plots, a result that was probably linked to the slightly higher plant population with the disc treatments (see Figure 5). However from flag leaf emergence (GS39) onwards there was no difference in DM production between the two different drill openers.

There was no significant interaction between row spacing and drill opener on harvest DM (p = 0.29), even though there appeared to be a trend to slightly higher harvest DM for the tine treatments at 30 and 37cm (see Figure 6).

Crop structure

Higher plant populations (160 plants/m²) resulting from the narrower row spacing resulted in the highest tiller populations, about 425 tillers/m². The lower plant population resulting from the wider row spacing produced, on average, 2.9 tillers/plant compared with 2.7 tillers/plant where higher plant populations established with the narrow row spacing (see Figure 7).

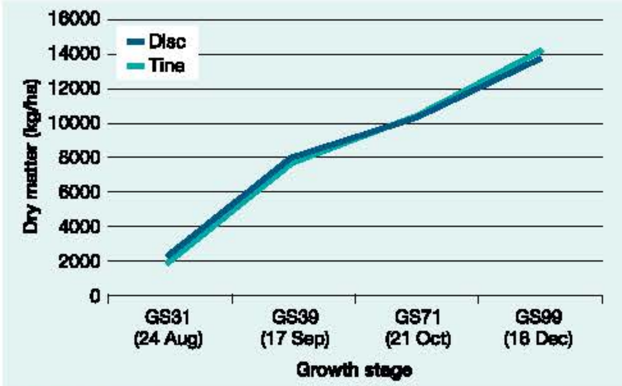

FIGURE 5 Influence of opener on dry matter production*
*Mean of three row spacings (24 August–16 December 2010)

Resultant head numbers revealed little tiller loss between GS31 and harvest, with significantly more heads/m² in the 22.5cm and 30cm row spacing treatments than the 37.5cm spacing.

There were no differences in crop structure between disc and tine treatments.

Yield (t/ha) and grain protein (%)

i) Yield

The trial yielded 4.91t/ha, about 1t/ha less than the identical first wheat after canola trial (same cultivar, sowing date and inputs) less than 30m away, which yielded 5.84t/ha. Despite all the same trends being exhibited in establishment and for DM data, as for the wheat following canola trial, there was no significant difference in yield between any of the treatments (p = 0.3). The results indicated that the higher biomass in this wheat-on-wheat rotation position did not translate to grain yield (as occurred in the first wheat trial at the same site). As such, the harvest index (proportion of biomass partitioned as grain) was lower at the narrower row spacing. The results are also in

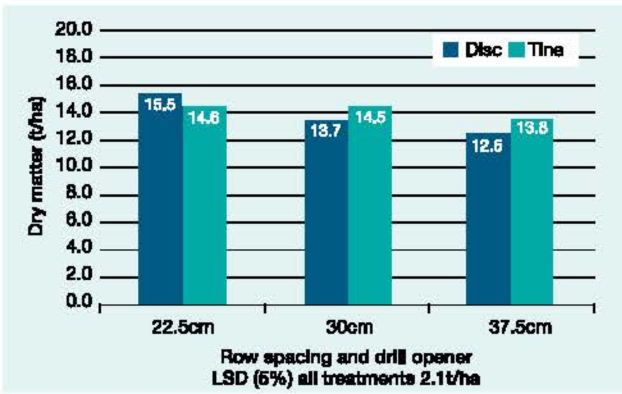

FIGURE 6 Influence of row spacing and drill opener on dry matter production at harvest*
* GS99 — 16 December 2010

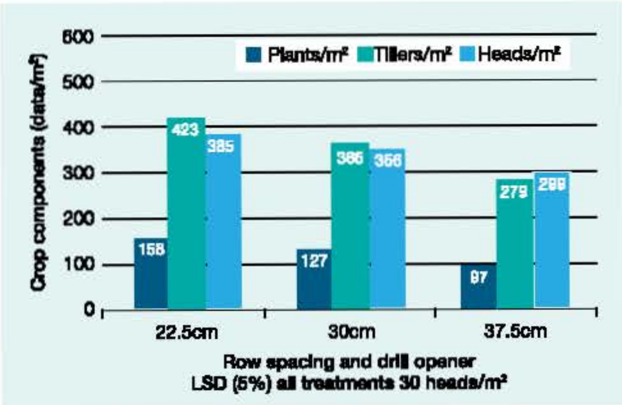

FIGURE 7 Influence of row spacing on crop structure

contrast to the preceding trial carried out during 2009, when wheat after canola was tested (see Figure 8).

Both drill openers produced near identical yields 4.90t/ha (disc) and 4.91t/ha (tine) when averaged across the different row spacings (see Figure 9). Again, there was no significant interaction between drill opener and row spacing, though as was the case with harvest DM, there appeared to be a slight yield disadvantage with the disc opener at 37.5cm (see Figure 10).

II. Protein (%) and nitrogen off-take

Despite the lack of yield difference, grain protein content was slightly higher at the widest row spacing ($p = 0.04$) (see Figure 11). The nitrogen content of the grain and straw at harvest illustrated only slight differences in total nitrogen off-take, 175kg/ha of nitrogen at the narrower row spacing and 165kg/ha at the widest row spacing (see Figure 12). This difference was the result of greater nitrogen off-take in straw/chaff at the narrow row spacing, since nitrogen off-take in the grain was identical between the narrowest and widest row spacing (108 kg/ha of nitrogen). Comparing the two trials side by side, first wheat after canola produced an average

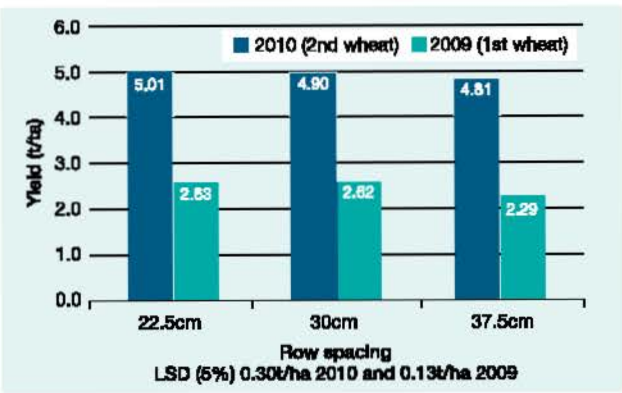

FIGURE 8 Influence of row spacing on yield during 2009 and 2010*
*Mean of both drill openers

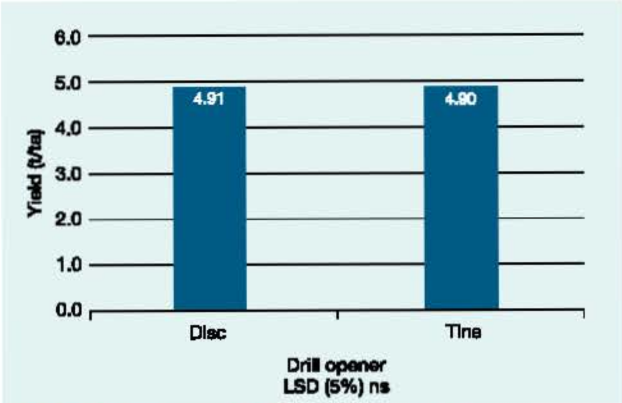

FIGURE 9 Influence of drill openers on yield*
*Mean of three row spacings

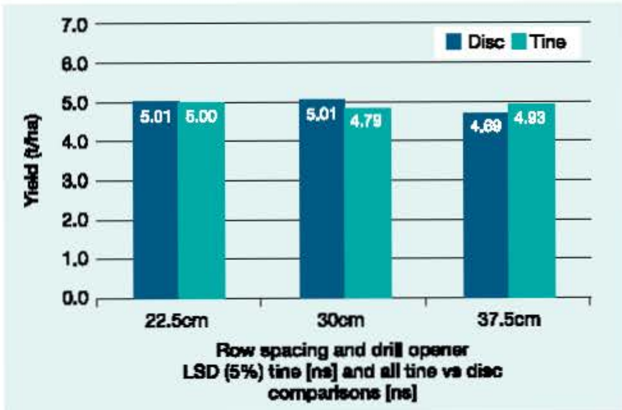

FIGURE 10 Influence of row spacing and drill opener on yield

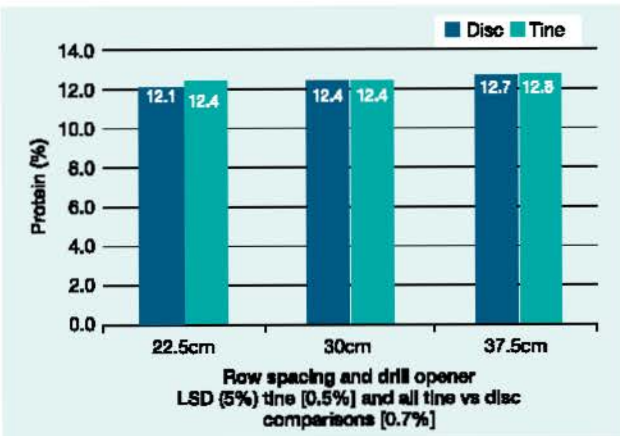

FIGURE 11 Influence of row spacing and drill opener on protein

of 5.84t/ha with 190kg/ha of nitrogen off-take, which equated to 32kg of nitrogen per tonne of production. In the second wheat after canola (wheat on wheat) the average trial yield was 4.91t/ha with 170kg/ha nitrogen off-take, which equated to 34.5kg of nitrogen per tonne of production.

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

Row spacing (cm)	Biomass (kg/ha)	Yield (kg/ha)	HI (%)	WUE [1] (kg/mm)	Transpiration [2] (mm)	Evaporation [3] (mm)	TE [4] (mm)
22.5	15038	5072	33.7	8.9	273	297	18.6
30.0	14118	4902	34.7	8.6	257	313	19.1
37.5	13181	4806	36.5	8.4	240	330	20.1

[1] Based on 570mm of GSR (April–mid-November) includes 35% fallow efficiency for January, February and March rainfall (160mm) 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 biomass/ha.mm transpired

[3] Difference between transpiration through the plant and GSR (mm)

[4] Transpiration efficiency based on kg/ha grain produced per mm of water transpired through the plant

* Mean of both openers

Observations and comments

Despite a lower harvest index and transpiration efficiency with the narrow row spacing, overall, the crop had slightly higher WUE (see Table 2). This was linked to better use of water available to the crop since it was calculated there was less evaporation/drainage at this spacing compared with the wide row spacing.

The DM harvest index (proportion of biomass partitioned as grain) was lower with narrower row spacing than wider row spacing.

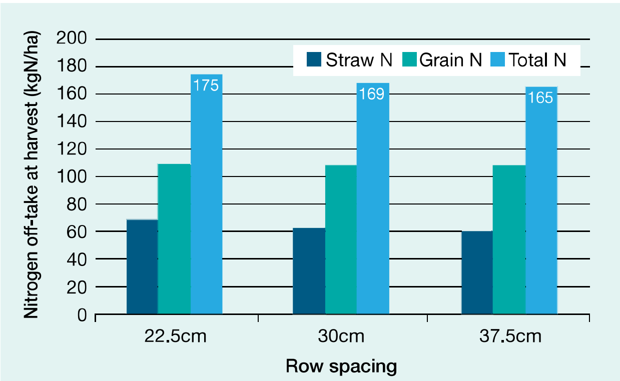

FIGURE 12 Influence of row spacing on nitrogen off-take in straw or chaff and grain

One possible explanation for the failure of the narrower row spacing to convert more biomass into more grain could have been greater root disease pressures in this wheat-on-wheat situation. Closer proximity of narrower rows to previous wheat stubble may have predisposed these treatments to greater infection, however at this stage this cannot be proven.

SPONSORS

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