Performance of 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

- With 570mm growing season rainfall (GSR) 2010 wheat yields were more than double those experienced during 2009 in the same rotation position (wheat after canola).
- Yield drop-off associated with the wide row spacing (37.5cm) was almost identical to 2009 results, with a 12% yield reduction compared with the narrow spacing (22.5cm).
- The narrow row spacing was significantly higher yielding than the 30cm row spacing, where there was no yield difference in 2009.
- Nitrogen off-take in the grain and straw at harvest was 10% higher with the narrow row spacing, however the harvest index was almost identical (about 38%) to wide rows.
- Although there was a 0.2t/ha yield advantage with the disc opener over the tine, it was not significant, however it was identical to the yield difference observed in 2009.
- Increasing canola stubble loading (extra 10t/ha) post emergence significantly reduced yield compared with the commercial canola stubble loading in the paddock.

Location: Coreen, NSW

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

Soil:
Type: Clay loam
pH (H_20): 5.9
pH ($CaCl_2$): 4.9

Sowing information:
Variety: Gladius, wheat
Sowing date: 27 May 2010
Sowing rate: 85kg/ha
Fertiliser: MAP + Intake
Seeding equipment: Janke tine with Janke press wheel, single disc opener
Treatments: Disc, tine, tine + extra stubble

Row spacing: 22.5cm, 30cm and 37.5cm

Paddock history:
2009 — canola
2008 — triticale

Plot size: 44m x 3m

Replicates: 4 (disc), 6 (tine) and 4 (tine + extra stubble)

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 in two no-till rotations.

Method

A replicated experiment was established to test the effect of a range of drill openers and row spacings in two no-till wheat rotations. In this trial, the crop was first wheat after canola.

Crop stubble from the previous canola crop trial (see *Research for the Riverine Plains 2010* pages 10–13) was chopped and spread at right angles to the direction of plots.

Results

Crop establishment

The establishment of wheat sown at the 22.5cm row spacing was significantly (p<0.001) better than crops sown at 30cm, which in turn was significantly superior to the 37.5cm row spacing.

It is still unclear why, at such early stages of establishment (one-leaf to three-leaf), the extra competition within the row at the wider row spacing should reduce establishment. However the results are consistent with those seen from last season's trial at this site (see Table 1 and Figure 1).

Disc openers resulted in significantly better establishment (p<0.001) than tine openers in this first wheat after canola crop (see Figure 2). While differences between establishment figures were small, the result is consistent with a trend seen in the equivalent rotation position last season.

Extra canola stubble added after emergence on 16 June had a small negative effect on establishment when assessed 20 days later at the three-leaf stage.

The effect of row spacing was similar across drill openers and there was no significant interaction between these two factors (see Figure 3).

Dry matter production

i) Row spacing

Wheat crops established at the 22.5cm row spacing produced significantly more dry matter (DM) than crops established at the 30cm and 37.5cm row spacings when assessed from the start of stem elongation (GS31) through until harvest (GS99) (see Figure 4). Though there was a consistent trend for the 30cm row

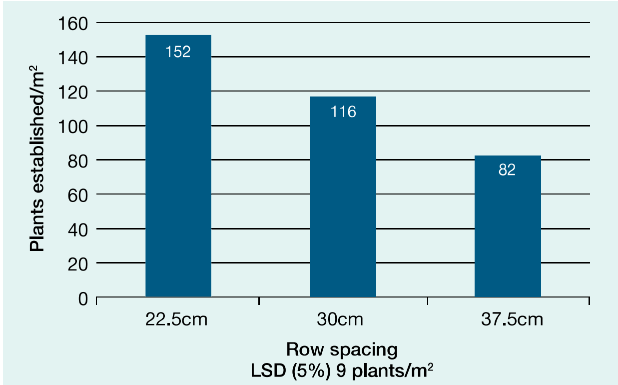

FIGURE 1 Influence of row spacing on plant establishment, at the three-leaves-unfolded stage (GS13) 39 days after sowing

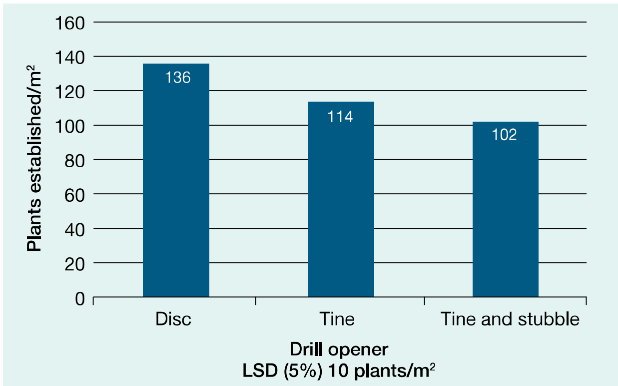

FIGURE 2 Influence of drill opener and additional stubble on crop establishment at the three-leaves-unfolded stage (GS13) 39 days after sowing

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

Row spacing (cm)	Drill opener[1] Plant establishment (plants/m²)							
	18 June 2010				5 July 2010			
	Disc	Tine	Tine + stubble[2]	Mean	Disc	Tine	Tine + stubble[2]	Mean
22.5	114	98	96	**103**	178	147	134	**153**
30.0	92	76	71	**80**	132	116	99	**116**
37.5	69	56	49	**58**	99	78	74	**84**
Mean	**92**	**77**	**72**		**136**	**114**	**102**	
LSD (row spacing)	5				9			
LSD (drill opener)	5				10			
LSD (disc) (tine)	10	7			18	13		
LSD (disc vs tine)	8				14			
Interactions — drill opener x row spacing					ns			

[1] Tine treatments had six replicates compared with four for the disc treatment and tine plus stubble
[2] Extra canola stubble (10t/ha) was added on emergence of wheat at GS11

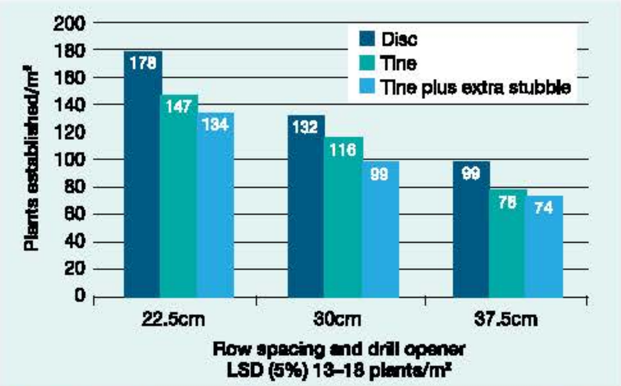

FIGURE 3 Influence of row spacing and opener method on plant establishment at three-leaves-unfolded stage (GS13) 39 days after sowing

spacing to be superior to the 37.5cm row spacing, this was only statistically significant during stem elongation (GS31 and GS39).

ii) Drill openers

The disc opener produced slightly higher DM than the tine opener following significantly better plant establishment during autumn. This advantage was greatest and most significant at flag leaf (GS39) and early grain fill (GS71).

This DM advantage had been eroded by harvest time so that there was no significant difference in DM between the tine and disc opener (p = 0.14).

Where the extra stubble loading was applied post emergence to the tine treatment, there was no effect on DM production, even though there appeared to be a visual reduction in DM from field observations (see Figure 5).

There was no significant interaction between row spacing and drill opener for total DM at harvest. Where extra stubble had been added to the tine treatment, DM trended to be higher at harvest (see Figure 6) than at early grain fill.

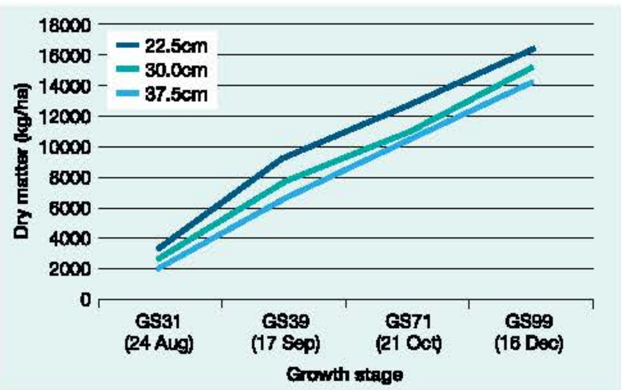

FIGURE 4 Influence of row spacing on dry matter production*
* Mean of both drill openers (24 August–16 December 2010)

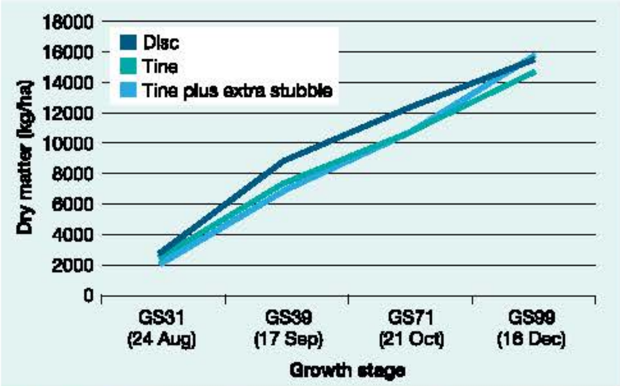

FIGURE 5 Influence of opener on dry matter production*
* Mean of three row spacings (24 August–16 December 2010)

Crop structure

Differences in plant establishment followed through to produce significant differences in both tiller numbers at first node (GS31) and head numbers at harvest (see Figure 7).

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

i) Yield

Row spacing produced significant yield differences (p = 0.001). The 22.5cm row spacing yielded significantly

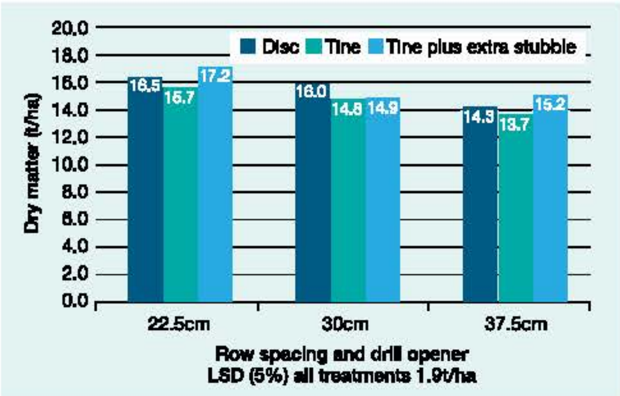

FIGURE 6 Influence of row spacing and drill opener on dry matter production at harvest*
* GS99–16 December 2010

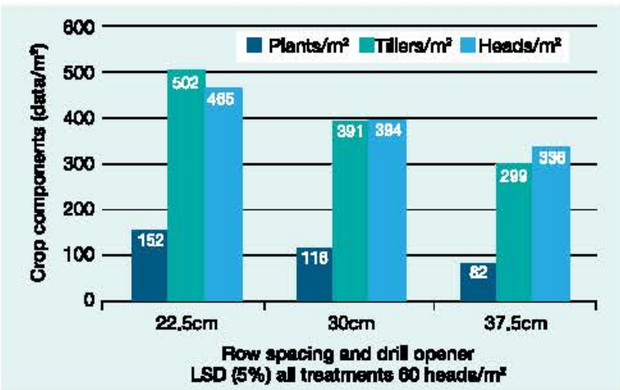

FIGURE 7 Influence of row spacing on crop structure

more than 30cm and 37.5cm row spacings. The reduction in yield compared with the 22.5cm row spacing was 7% for the 30cm row spacing and 12% at the 37.5cm spacing (see Figure 8).

In an equivalent trial (same point in rotation) at this site in 2009, the yields were less than 50% of those recorded in 2010. However the percentage drop in output at the 37.5cm row spacing was almost identical at 13%, though there was no significant difference between 22.5cm and 30cm spacings in that lower-yielding season.

There was a 0.21t/ha yield advantage in favour of the disc opener in this trial (though not statistically significant) — a result almost identical to that produced in the same comparison during 2009. Where stubble loading was increased with the tine treatment (10t/ha of canola stubble added at crop emergence), yield was significantly lower than the equivalent tine treatment having only the field stubble loading (3–3.5t/ha) (see Figure 9).

There was no significant interaction between row spacing and the drill opener, therefore the 22.5cm row spacing was significantly better than other row spacings, irrespective of opener and stubble loading (see Figure 10).

The disc opener combined with the 22.5cm row spacing, showed a trend to being the highest yielding combination but it was not significantly superior to the other drill opening stubble loading combinations tested at the same row spacing.

ii) Protein (%) and nitrogen off-take

Grain protein content gave an inverse relationship with yield, such that the higher the yield the lower the protein (see Figure 11). The nitrogen (N) content of the grain and straw at harvest showed higher nitrogen off-takes with treatments that produced the highest yields and biomass — at the narrowest row spacing (see Figure 12).

The 22.5cm row spacing removed, on average, 200kg/ha of nitrogen to produce yields of 6.2t/ha compared with 180kg/ha nitrogen off-take at the widest row spacing, which yielded 5.5t/ha.

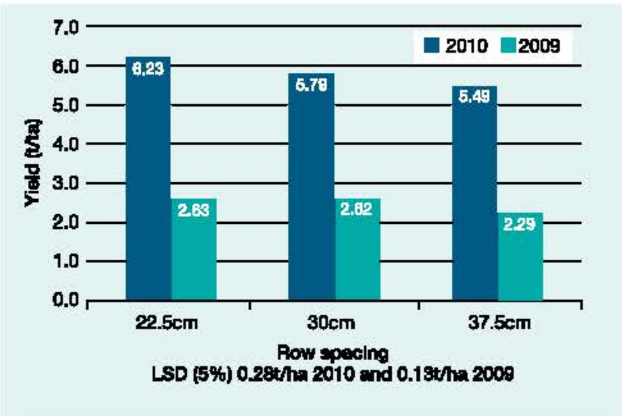

FIGURE 8 Influence of row spacing on yield during 2009 and 2010*

* Mean of both drill openers.

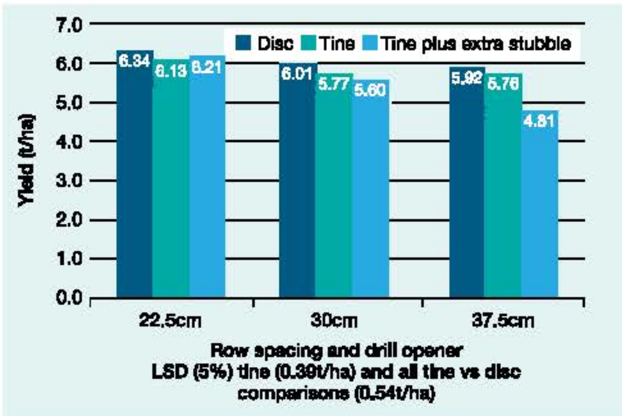

FIGURE 10 Influence of row spacing and drill opener on yield

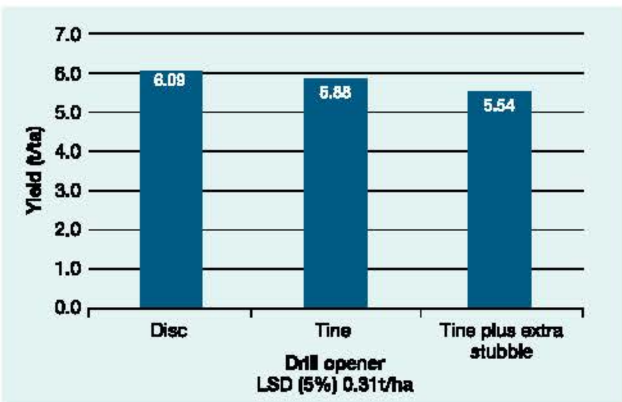

FIGURE 9 Influence of drill openers and extra stubble on yield*

* Mean of three row spacings

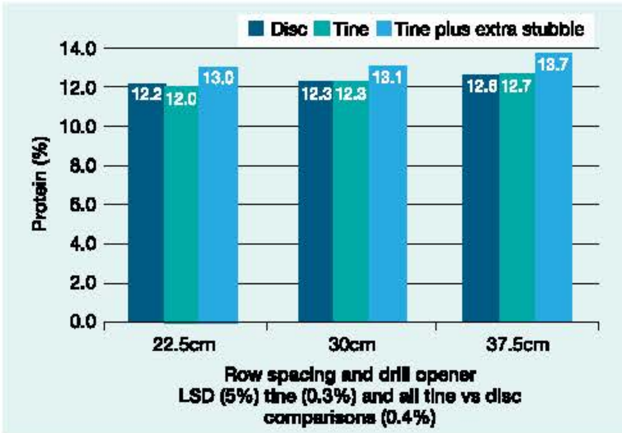

FIGURE 11 Influence of row spacing and drill opener on protein

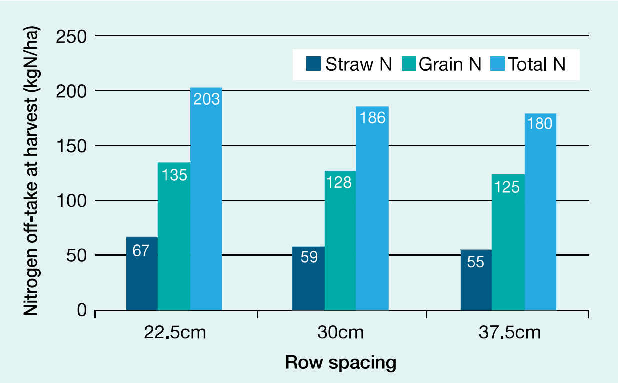

FIGURE 12 Influence of row spacing on nitrogen off-take in straw or chaff and grain

Observations and comments

There was little difference in harvest index (37.8–38.1%) due to row spacing. As biomass increased with a narrower row spacing, so did grain yield.

Slightly higher WUE was recorded with the narrower row spacing, resulting from better use of water available to the crop. Losses due to evaporation (and possibly drainage) were calculated to have been lower with the narrow row spacing than those for the wider row spacings (see Table 2).

SPONSORS

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

Row spacing (cm)	Biomass (kg/ha)	Yield (kg/ha)	HI (%)	WUE [1] (kg/m)	Transpiration [2] (mm)	Evaporation [3] (mm)	TE [4] (kg/mm)
22.5	16,466	6226	37.8	10.9	299	271	20.8
30.0	15,263	5795	38.0	10.2	278	292	20.9
37.5	14,402	5494	38.1	9.6	262	308	21.0

[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 water 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 and additional stubble treatment