The interaction between stubble height and light interception in canola

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Key points

- When canola was sown into wheat stubble in an east-west direction, long stubble (42cm) significantly reduced photosynthetically active radiation (PAR) and reduced true leaf number up to mid-winter.
- Although there were trends suggesting a reduction in dry matter (DM) production at the yellow bud stage (GS3.7) as a result of increasing stubble height, the differences were not statistically significant.
- The average canola yield of the trial was 1.58t/ha with no significant differences in either yield or oil content due to stubble height of the previous wheat crop.
- The results mirror a trial conducted at Dookie, where yields in long stubble were 3.70t/ha and 3.75t/ha in short stubble. At this site there were significant reductions in DM production early in the season in the long stubble treatment.

Sowing date: 2 May 2017
Rotation: Canola following wheat
Variety: Bonito
Stubble: Wheat unburnt
Rainfall:
GSR: 270mm (April–October)
Summer rainfall: 88mm
Soil mineral nitrogen:
0–10cm: 26kg N/ha (February 2017)
0–100cm: 109kg N/ha (June 2017)

Previous findings

One of the most consistent findings of the GRDC investment in the *Maintaining profitable farming systems with retained stubble in the Riverine Plains region (2013–18)* project has been the influence of long stubble in no-till stubble retention (NTSR) systems on the growth of the following crop. Longer stubbles (30–45cm) in NTSR systems have been associated with lower dry matter (DM) production and slower development through winter until spring, after which the crop invariably compensates. In some trials this delay in development and reduction in biomass (DM) has impacted yield, although in other trials it has not. This trial was established to look at the effect of stubble height on subsequent crops in more detail.

Method

A trial was established during 2017 under the Riverine Plains Inc stubble project: *Maintaining profitable farming systems with retained stubble in the Riverine Plains region (2013–18)*. The trial was carried out near Rennie, NSW.

Three different stubble height treatments were created in a commercial wheat stubble before establishing canola. The stubble rows ran in an east-west direction, with a row spacing of 25cm. The plots were 10m x 10m and each treatment was replicated three times. The trial was sown with a commercial crop of canola (cv Bonito) through the different stubble height treatments. The trial design was a randomised complete block. All paddock management was undertaken by the host farmer and was uniform for the trial site.

A ceptometer was used early in the season to measure photosynthetically active radiation (PAR) in each treatment and determine the effect of shading in each stubble length.

TinyTag temperature loggers were placed in the centre of each plot at a start height of 30cm and final height of 90cm, moving up as the canopy grew. Canopy temperatures were measured every hour to explore any differences due to stubble height.

The three lengths of stubble created ranged from 12–42cm (Table 1), with the extra residue cut to produce the shorter stubble lengths being left on the ground in the plot.

Results

i) Establishment and crop structure

When canola establishment was assessed at the four-leaf stage (GS1.04) there was no difference in crop establishment due to stubble length (Table 2).

TABLE 1 Stubble treatments

Stubble treatment	Stubble height (cm)
Short	12
Medium	21
Long	42

TABLE 2 Plant counts 29 May 2017, four-leaf stage (GS1.04)

Treatment	Plants/m²
	GS1.04
Short (12cm)	34[a]
Medium (21cm)	37[a]
Long (42cm)	35[a]
Mean	**35**
LSD	7

There was a significant difference in the number of true leaves produced by the canola crop under the different stubble length treatments (Figure 1). By July the crop sown into short stubble (12cm) had developed at least one extra leaf compared with the crop established in long stubble (42cm). The intermediate stubble length (21cm) had a smaller reduction in the number of true leaves produced.

ii) Temperature

Although there were small differences in accumulated temperatures across the main growing season (when recorded at 30cm at the start of the season and 90cm towards the end of the season), these differences in temperature were not statistically significant (Figure 2).

iii) Photosynthetically active radiation (PAR)

The assessments of photosynthetically active radiation (PAR) indicated that stubble height had a significant influence on the percentage of light intercepted by the crop. The long stubble (42cm) caused a significant shading effect on the young plants, more than halving the PAR available to the crop compared with the light available to the crop in short stubble (12cm) (Figure 3).

With the east-west row orientation the differences in PAR between stubble heights were similar, irrespective of whether measurements were made at 9am, 12 noon or 3pm.

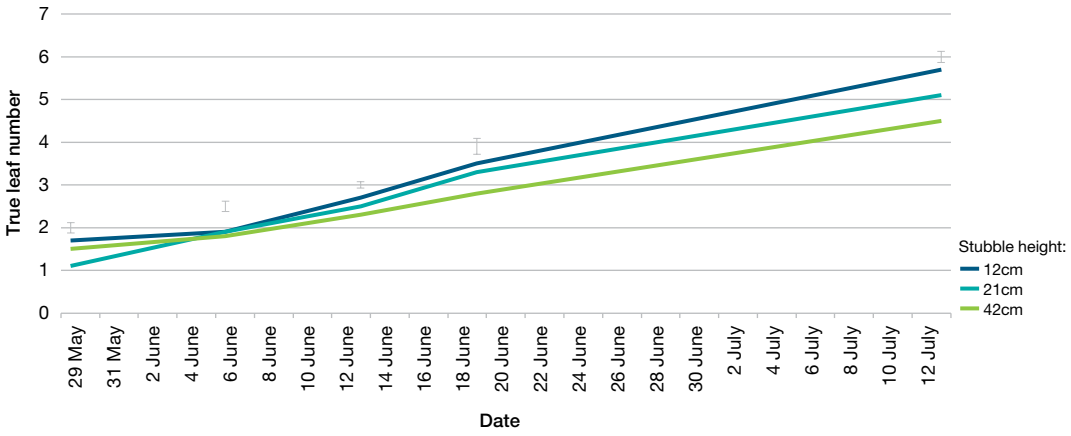

FIGURE 1 Influence of previous crop stubble length on true leaf number in canola on 29 May 2017, 6 June 2017, 13 June 2017, 19 June 2017 and 13 July 2017

* The error bars are a measure of LSD.

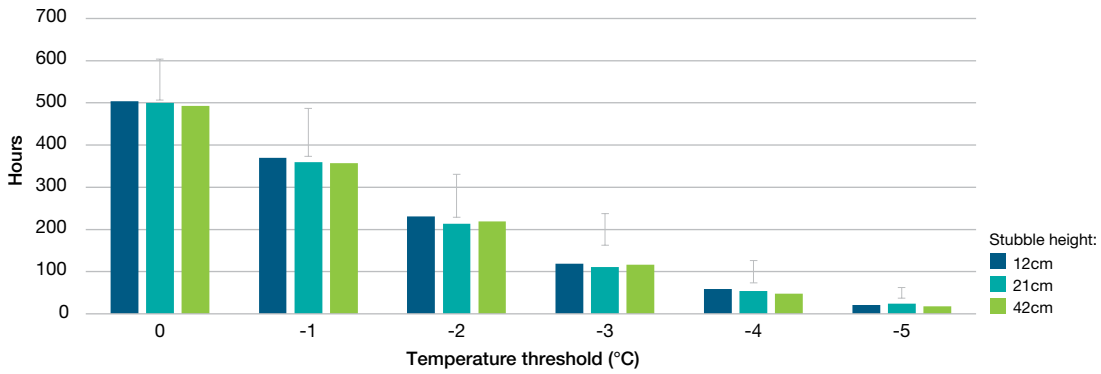

FIGURE 2 Hours spent below each temperature threshold for canola canopy in 12cm, 21cm and 42cm stubble height treatments, from 17 May 2017 until 21 November 2017

* The error bars are a measure of LSD.

1 *Long stubble treatment (42cm), 27 March 2017*

2 *Medium length stubble treatment (21cm), 27 March 2017*

3 *Short stubble treatment (12cm), 27 March 2017*

4 *Measuring PAR using a ceptometer in long stubble (42cm), 19 June 2017*

5 *Short stubble treatment (12cm), 18 August 2017*

6 *Long stubble (42cm) treatment, 18 August*

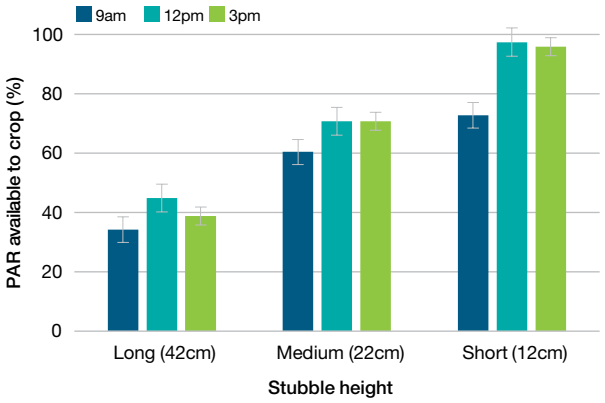

FIGURE 3 Influence of stubble height on availability of photosynthetically active radiation at 9am on 6 June 2017, 12pm on 13 June 2017 and 3pm on 19 June 2017 at Rennie, NSW

* The error bars are a measure of LSD and comparison can only be made when comparing bars of the same colour (i.e. when measurements were made at the same time on the same day).

Note:

6 June readings were taken at 9am, with the average above-canopy PAR measuring 573µmol/m²/s in the 400–700nm waveband.

13 June readings were taken at 12pm with the average above-canopy PAR measuring 948µmol/m²/s¹ in the 400–700nm waveband.

19 June readings were taken at 3pm, with the average above-canopy PAR measuring 583µmol/m²/s¹ in the 400–700nm waveband.

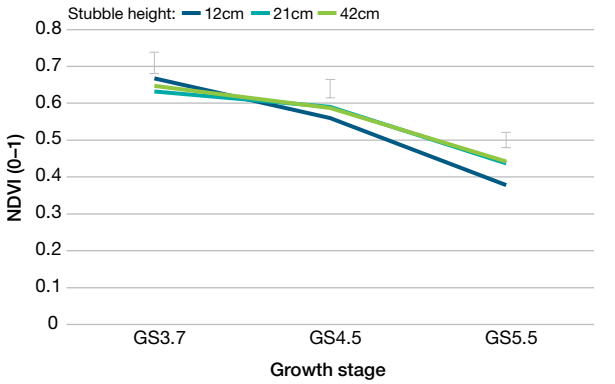

FIGURE 4 NDVI readings on 18 August 2017, yellow bud (GS3.7); 13 September 2017, 50% flowering (GS4.5) and 12 October 2017, 50 % pods on raceme more than 2cm (GS5.5)

* Error bars are a measure of LSD.

iv) Dry matter production

Although there was a trend for canola in longer stubble to produce less DM compared with canola in shorter stubble at the yellow bud stage (GS3.7), the difference was not statistically significant (Table 3). At the pod maturity stage (GS6.7), when seeds were mainly black, the same non-significant trend was also apparent.

A DM assessment was conducted at full flowering, however problems with the drying oven meant results could not be used.

v) Normalised difference vegetative index (NDVI)

Measurements of crop reflectance made using a Greenseeker™ showed little difference in crop canopy NDVI (Figure 4) across stubble height treatments.

TABLE 3 Dry matter production 18 August 2017, yellow bud (GS3.7) and 21 November 2017, most seeds black but soft (GS6.7)

Treatment	Dry matter (t/ha)	
	GS3.7	GS6.7
Short (12cm)	2.17[a]	6.95[a]
Medium (21cm)	1.90[a]	6.81[a]
Long (42cm)	1.88[a]	6.85[a]
Mean	**1.98**	**6.87**
LSD	0.32	0.69

TABLE 4 Yield and quality at harvest (GS6.9), 21 November 2017

Treatment	Yield and quality	
	Yield (t/ha)	Oil (%)
Short (12cm)	1.57[a]	46.1[a]
Medium (21cm)	1.47[a]	46.6[a]
Long (42cm)	1.69[a]	45.6[a]
Mean	**1.58**	**46.1**
LSD	0.39	1.1

vi) Grain yield and oil content

The trial was harvested on 21 November 2017 with an average yield of 1.58t/ha. Stubble height had no significant influence on yield or oil content (Table 4).

Acknowledgements

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