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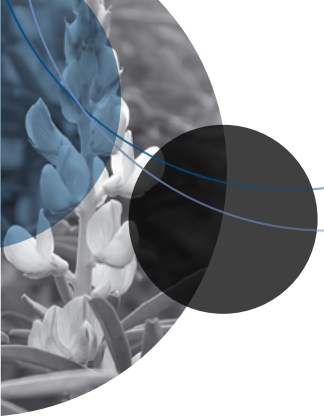

Agronomy – canola

Optimising growth and avoiding stress to canola through sowing date, variety choice and nitrogen management

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Key findings

- Highest yields were obtained when flowering started in early to mid-August. Treatments that flowered in July were affected by frost and treatments that flowered in September were affected by heat and drought.
- The strongest yield response to nitrogen was on treatments that flowered in early to mid-August.
- Hybrids tended to recover better from frost damage than open-pollinated (OP) triazine tolerant (TT) varieties, but flowering date and nitrogen management were more important to maximise yield potential than variety type.
- The highest oil concentration was obtained from varieties that flowered in early to mid-August.

Introduction

In the 'Optimised canola profitability project, data from 2014 to 2016 showed strong correlations between total biomass (at crop maturity) and grain yield. The purpose of experiments conducted in 2017 was to determine the optimum combination of sowing date, nitrogen management and variety for growth, grain yield and oil concentration. Eight canola varieties with diverse phenology, herbicide tolerance and breeding type were sown on two sowing dates with two rates of nitrogen applied across all treatments.

Site details

Location	Ganmain, 60 km north-west of Wagga Wagga
Soil type	Brown chromosol
Previous crop	Wheat
Fallow rainfall	180 mm (November 2016–March 2017)
In-crop rainfall	190 mm (April 2017–October 2017), (long-term average = 300 mm)
Soil pH_{Ca}	5.6 (0–10 cm, 13 April)
Soil nitrogen	123 kg/ha (0–120 cm, 13 April)
Soil phosphorus	65 mg/kg (Colwell, 0–10 cm)
Starter fertiliser	100 kg/ha MAP (mono-ammonium phosphate) (11% nitrogen [N], 22.7% phosphorus [P], 2% sulfur [S]), treated with 2.8 L/tonne flutriafol (500 g/L)

Treatments

Varieties	Nuseed® Diamond	Fast spring, conventional herbicide hybrid
	ATR Stingray$^{\Phi}$	Fast spring, TT, OP
	Pioneer® 44Y90 CL	Mid–fast spring, Clearfield® hybrid
	ATR Bonito$^{\Phi}$	Mid–fast spring, TT, OP
	Hyola® 600RR	Mid spring, Roundup Ready® hybrid
	Pioneer® 45Y25 RR	Mid spring, Roundup Ready® hybrid
	ATR Wahoo$^{\Phi}$	Slow spring, TT, OP
	Archer	Slow spring, Clearfield® hybrid
Sowing date (SD)	SD1: 8 April	
	SD2: 26 April	
Nitrogen rates	70 kg N/ha	Spread pre-sowing and incorporated by sowing (IBS).
	170 kg N/ha	70 kg N/ha applied at sowing (as above) plus 100 kg N/ha broadcast 4 July.

Results

Seasonal conditions

Frosts at Ganmain in 2017 were frequent and severe, including 1 July (–5.5°C), 2 July (–4.1°C), 22 July (–3.5°C), 20 August (–3.4°C), 26 August (–3.1°C), 28 August (–4.4°C), 29 August (–5.7°C), 30 August (–3.5°C) and 17 September (–4.6°C). Rainfall was also well below average and a heat stress day of 36.3°C occurred on 23 September.

Phenology and frost damage

A frost scoring system was developed where the number of viable seeds was counted in 20 pods from the main stem, in each plot. There was a strong relationship between flowering date and the number of viable seeds per pod (Figure 1). Early sown Nuseed® Diamond and ATR Stingray$^{\Phi}$ flowered in early July and both averaged less than six seeds per pod on the main stem. From the same sowing date, flowering in Archer and ATR Wahoo$^{\Phi}$ was delayed until early–mid August and both had more than 10 viable seeds per pod. This scoring gave an insight into the level of frost damage in each variety, but did not completely relate to grain yield, as there were differences in the ability to compensate from frost damage through forming new pods.

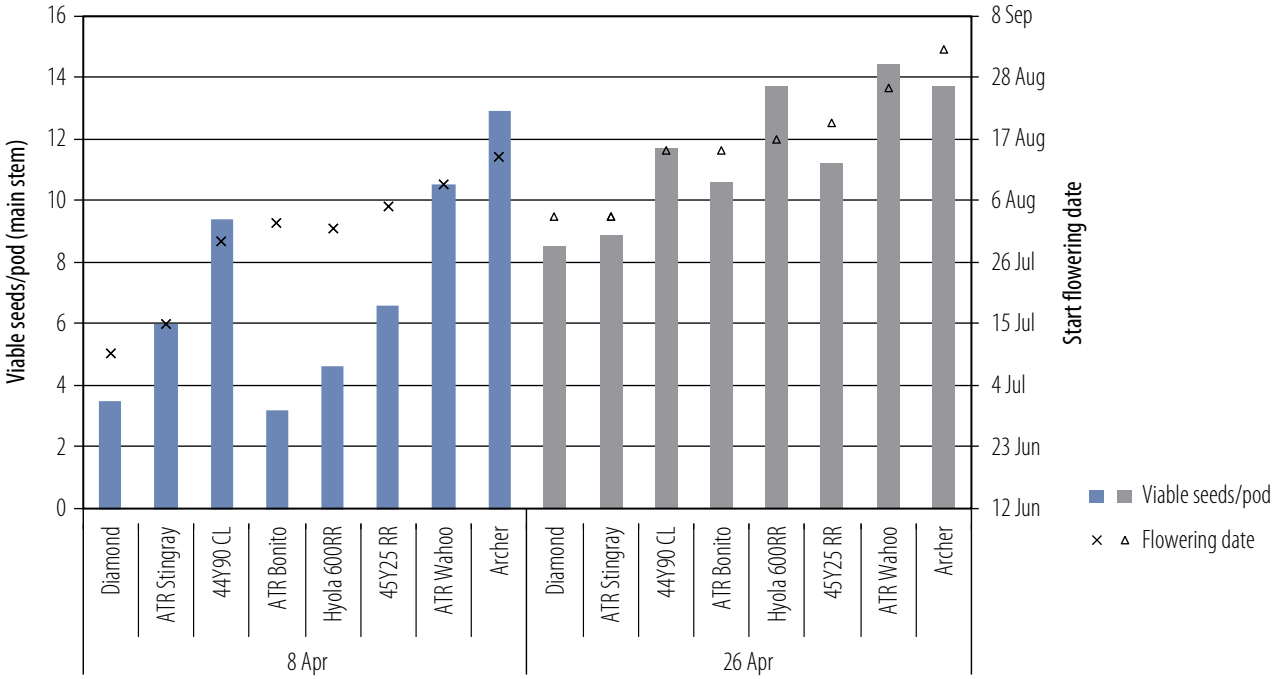

Figure 1. Viable seeds per pod (columns) and flowering date (× and Δ) of eight canola varieties sown on two sowing dates (averaged across N rates) at Ganmain, 2017 (viable seeds/pod l.s.d. $P<0.05 = 2.1$).

Grain yield

Highest yield occurred when varieties were sown in the window that achieved the optimum flowering date (early August) and where they were well fertilised with N. The fast varieties' yields (Nuseed® Diamond and ATR Stingray$^{\phi}$) were severely penalised by frost from the early sowing and subsequent early flowering (see flowering dates in Figure 1). The yields of slower varieties (e.g. Archer and ATR Wahoo$^{\phi}$) were reduced from later sowing, as flowering occurred later (late August to early September) than optimal and pod development was limited by rising spring temperatures (Figure 2).

Importantly, the yield response to N increased for varieties sown in their correct window. For example, there was a strong response to N in Archer, Pioneer® 45Y25 (RR) and ATR Wahoo$^{\phi}$ sown early (flowering in early August), but minimal response when sown later (flowering in later August). Conversely there was a strong response to N in Nuseed® Diamond when sown later (flowering in early August), but not when it was sown early (flowering in early July). Both Pioneer® 44Y90 CL and Hyola 600RR responded well to N at both sowing dates (Figure 2).

Sowing hybrid varieties was beneficial; however, varietal choice was less important than ensuring optimum sowing date, phenology and nitrogen management. For example, sowing the OP TT variety ATR Wahoo$^{\phi}$ (2.8 t/ha) early with a high rate of N yielded 0.7 t/ha more than the experiment mean yield of 2.1 t/ha, whereas there were several treatments where hybrids with sub-optimal management (low N or incorrect sowing date) yielded less than the experiment mean.

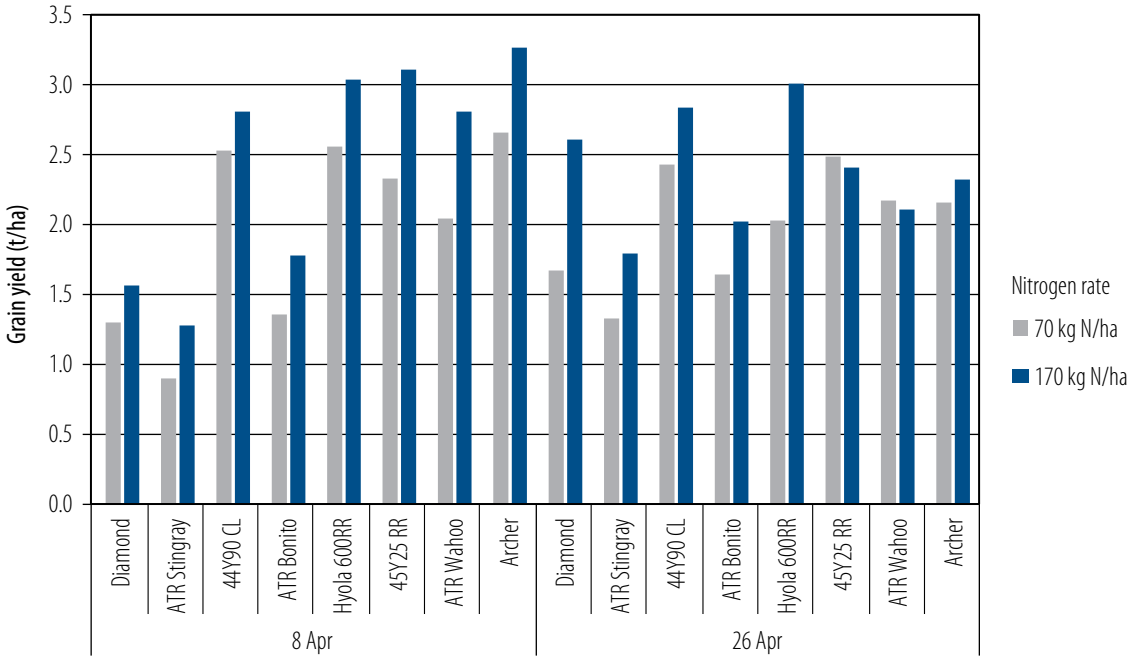

Figure 2. Grain yield of eight canola varieties sown on two sowing dates and fertilised at two nitrogen (N) rates at Ganmain, 2017 (l.s.d. $P<0.05 = 0.38$ t/ha).

Oil concentration

Flowering date had a strong effect on oil concentration. Early sown Nuseed® Diamond and ATR Stingray$^{\phi}$, which flowered in early–mid July, had an oil concentration around 37% (Table 1), whereas treatments that flowered in mid-August (see Figure 1) had oil concentrations above 42%. Oil was reduced by 1% (across all treatments) where the N rate increased from 70 kg/ha to 170 kg/ha (data not shown).

Table 1. Oil concentration (%) of eight canola varieties sown on two sowing dates (averaged across two N rates) at Ganmain, 2017. The varieties are ranked from fastest to slowest development.

Variety	Sowing date	
	8 Apr	26 Apr
Nuseed Diamond	36.5	39.2
ATR Stingray	37.0	40.2
ATR Bonito	39.9	43.0
Pioneer 44Y90 (CL)	41.0	43.0
Hyola 600RR	42.2	45.7
Pioneer 45Y25 (RR)	42.1	44.4
ATR Wahoo	42.8	44.4
Archer	43.3	42.5
l.s.d. ($P<0.05$)	1.0	

Relationship between biomass and grain yield

Similar to previous seasons, growing a large quantity of biomass (above 10 t/ha) was necessary to achieve a high grain yield (above 2.5 t/ha). However, in contrast to previous seasons, growing a large quantity of biomass did not guarantee a high grain yield as frost reduced the grain number of early-flowering treatments (Figure 3). For example early sown Nuseed® Diamond had 11.4 t/ha of biomass at maturity and only yielded 1.4 t/ha, whereas Pioneer® 45Y25 (RR) grew a similar amount of biomass, flowered later (with less frost damage) and yielded 2.6 t/ha.

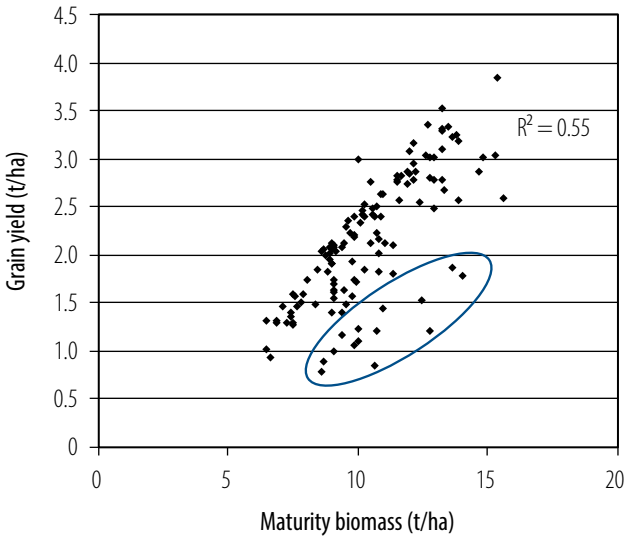

Figure 3. Relationship between maturity biomass and grain yield of canola at Ganmain in 2017. The oval marks treatments that were severely frost-affected so had a low conversion of biomass into grain yield.

Conclusion

Although rainfall was low and frost incidence and severity was high in 2017, canola was still a productive option for growers. The yield response from correctly matching sowing date with phenology was the main message from 2017, reaffirming a consistent result from canola research conducted in recent years. Growers are advised to aim to have crops flowering close to the optimum start of flowering date for the environment in which they are grown; these dates are summarised in the E-Book *10 tips for early sown canola* (Lilley et al. 2017). Secondly, benefits are obtained by managing the crop with optimum nitrogen fertility. Finally, with those factors in place, hybrid varieties can take grain yield to the next level, but varietal choice is not a 'silver bullet' in isolation.

This experiment will be continued across several sites in 2018 with some minor adjustments made to the varieties sown. More detailed economic analysis will be conducted after the experiments are completed.

Reference

Lilley J, Kirkegaard J, Brill R and Ware A 2017, 'Ten tips to early-sown canola': www.grdc.com.au/10TipsEarlySownCanola, accessed 31 March 2017.

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