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Effect of sowing date on phenology and yield of eight canola varieties – Leeton 2017

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Key findings

- The winter canola varieties SF Edimax CL and Hyola® 970CL achieved consistently high yields for all three sowing dates (late March to early May).
- All spring varieties (except Victory® V7001 CL) were penalised by early sowing due to frost damage, with yields increasing as sowing time was delayed.
- The yield of the slowest-developing spring variety, Victory® V7001 CL, was stable but relatively low across sowing dates.
- Early sowing fast-developing spring varieties exposes them to a greater risk of frost damage.

Introduction

This experiment was designed to improve the understanding of canola's yield potential and the effect from abiotic stress at different growth stages in the high-yielding irrigated zone of southern NSW. Improved understanding will help growers to select the appropriate plant type and sowing date so that environmental stresses are minimised and the critical growth period coincides with the most favourable conditions. Eight canola varieties with differing phenology were evaluated over three sowing dates from late March to early May.

Site details

Location	Leeton Field Station, Yanco
Soil type	Grey self-mulching clay
Previous crop	Barley (irrigated)
In-crop rainfall	145 mm (1.45 ML) (April 2017–October 2017)
Irrigation (estimate)	440 mm (4.4 ML)
Soil nitrogen (N)	64 kg/ha (0–60 cm, 29 April)
Nitrogen applied	20 March: 250 kg urea/ha = 115 kg N/ha 20 March: 100 kg Gran-Am/ha = 20 kg N/ha At sowing: 100 kg/ha mono-ammonium phosphate (MAP) = 10 kg N/ha First topdressing (8 leaf, 17 May to 22 June): 150 kg/ha urea = 65 kg N/ha Second topdressing (visible bud, 14 June to 1 September): 150 kg/ha urea = 65 kg N/ha

Treatments	Varieties		
	Nuseed® Diamond	Fast developing, conventional herbicide hybrid variety (spring type)	
	Pioneer® 44Y90 (CL)	Mid-fast developing, Clearfield® (CL) hybrid variety (spring type)	
	ATR Bonito [Ⓛ]	Mid-fast developing, triazine tolerant (TT), open-pollinated (OP) variety (spring type)	
	Pioneer® 45Y25 (RR)	Mid-slow developing, Roundup Ready® (RR) hybrid variety (spring type)	
	ATR Wahoo [Ⓛ]	Mid-slow developing, TT OP variety (spring type)	
	Victory® V7001 CL	Slow developing, CL hybrid variety (spring type)	
	SF Edimax CL	Very slow developing, CL hybrid variety (winter type)	
	Hyola® 970CL	Very slow developing, CL hybrid variety (winter type)	
	Sowing date (SD)	SD1: 27 March 2017	
		SD2: 11 April 2017	
		SD3: 2 May 2017	

Results

Phenology

Nuseed® Diamond was the fastest developing variety from the first sowing date and started flowering on 1 June, only 65 days after sowing (Figure 1). The development of Nuseed® Diamond is driven only by thermal time, (has no vernalisation requirement), therefore warmer temperatures hasten its development. Hyola® 970CL was the slowest variety to start flowering from the first sowing date, taking 176 days from sowing. Hyola® 970CL is a winter variety and has a strong vernalisation requirement, therefore it will not start flowering until after winter finishes. Victory® V7001 CL was the slowest spring variety to start flowering from the first sowing date, taking 131 days from sowing to flowering. Slower developing spring varieties have a response to both thermal time and vernalisation. Most spring varieties have only a small response to vernalisation, but this will delay flowering when conditions are warm (i.e. from early sowing). The stronger the influence of vernalisation, the greater the delay to flowering.

There were three major frosts during winter: 1 July, 22 July and 29 August. The temperature on 29 August fell to -4.5°C when most of the early-sown spring varieties were podding and susceptible to frost damage.

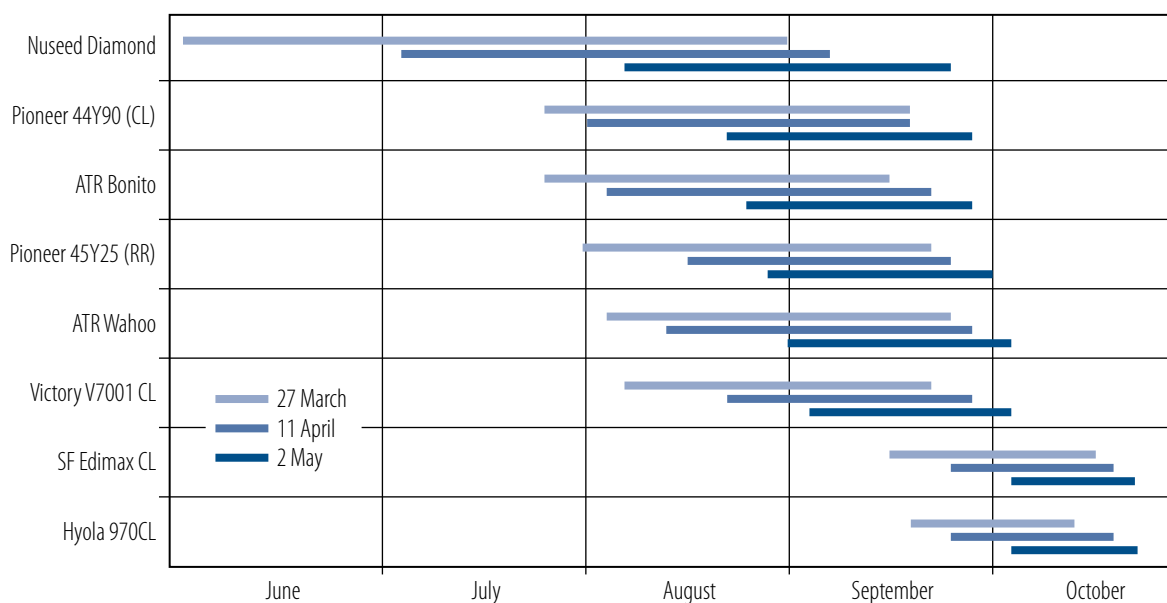


Figure 1. Flowering window of eight canola varieties sown on three sowing dates at Leeton, 2017.

Grain yield

Pioneer® 45Y25 (RR) (SD3) achieved the highest yield, 4.7 t/ha, while Nuseed® Diamond (SD1) recorded the lowest yield, 2.27 t/ha (Table 1). The two winter varieties, SF Edimax CL and Hyola® 970CL, and the slowest developing spring variety Victory® V7001 CL, had no yield response to sowing time with a consistent yield across all three sowing dates. The faster developing spring varieties showed a strong response to sowing time with a significant yield increase as sowing time was delayed. Frost penalised the early sown spring varieties, but as sowing was delayed, yield increased to match that of the winter varieties.

Harvest index

ATR Wahoo^d achieved the highest harvest index (HI) of 0.32 from SD2, while Nuseed® Diamond recorded the lowest HI of 0.15 from SD1 (Table 1). The HI of the two winter varieties, SF Edimax CL and Hyola® 970CL, and the slowest developing spring variety Victory® V7001 CL, had no response to sowing time and maintained a consistent HI across all sowing dates. The faster developing spring varieties had a strong response to sowing time with a significant increase in HI as sowing time was delayed.

Table 1. Grain yield (t/ha) and harvest index of eight canola varieties sown on three sowing dates at Leeton, 2017.

Variety	Grain yield (t/ha)			Harvest index		
	27 March	11 April	2 May	27 March	11 April	2 May
Nuseed Diamond	<u>2.27</u>	3.04	4.30	<u>0.15</u>	0.18	0.28
Pioneer 44Y90 (CL)	3.26	4.05	3.95	0.20	0.25	0.27
ATR Bonito	3.00	3.38	3.80	0.22	0.26	0.31
Pioneer 45Y25 (RR)	3.37	4.42	4.71	0.21	0.26	0.30
ATR Wahoo	2.99	3.65	4.02	0.21	0.32	0.30
Victory V7001 CL	3.16	3.54	3.57	0.21	0.23	0.23
SF Edimax CL	4.70	4.61	4.21	0.28	0.30	0.29
Hyola 970CL	4.16	4.55	4.23	0.27	0.31	0.29
l.s.d. ($P < 0.05$)		0.77		0.047		

Bolded numbers indicate the highest value and underlined numbers indicate the lowest value for each group.

Number of viable grains per pod

Hyola® 970CL achieved the highest seed number with 24 viable grains per pod from SD1, while Nuseed® Diamond recorded the lowest seed number with 2.5 viable grains per pod at SD1. There was a significant relationship of viable grains per pod to sowing time across all varieties. The two winter varieties, SF Edimax CL and Hyola® 970CL, had a significant reduction in grains per pod as sowing time was delayed, whilst the spring varieties had a strong response to sowing time, but with an increase in grains per pod as sowing time was delayed.

Frost assessment

Twenty pods were collected from each plot (main stem only) at the end of flowering then opened and assessed for the number of viable seeds and the number of potential seed sites. Hyola® 970CL had the highest proportion of viable grains per pod at 74.7% from SD1 as it flowered after the last damaging frost in late winter. Nuseed® Diamond recorded the lowest proportion of viable grains per pod at 8.6% from SD1 as it was the earliest flowering variety and the most affected by frost. The two winter varieties, SF Edimax CL and Hyola® 970CL had a significant reduction in the proportion of viable grains per pod as sowing time was delayed, however, the spring varieties had a significant increase in the proportion of viable grains per pod as sowing time was delayed and frost was avoided.

Table 2. Grains per pod and percentage of viable grains per pod of eight canola varieties sown on three sowing dates at Leeton, 2017.

Variety	Viable grains (number per pod)			Proportion of viable grains per pod (%)		
	27 March	11 April	2 May	27 March	11 April	2 May
Nuseed Diamond	<u>2.5</u>	3.7	14.7	<u>8.6</u>	12.8	46.1
Pioneer 44Y90 (CL)	8.5	11.2	16.1	30.0	39.1	53.5
ATR Bonito	7.2	10.4	18.0	24.2	31.4	52.1
Pioneer 45Y25 (RR)	8.4	13.2	15.5	27.9	42.0	50.5
ATR Wahoo	14.4	15.7	21.8	45.3	46.1	64.5
Victory V7001 CL	10.0	12.9	14.0	36.8	48.9	51.8
SF Edimax CL	21.5	16.5	17.5	66.4	54.2	56.1
Hyola 970CL	24.0	21.2	19.6	74.7	67.3	61.0
<i>l.s.d. (P<0.05)</i>		3.71			11.37	

Bolded numbers indicate the highest value and underlined numbers indicate the lowest value for each group.

Conclusion

Sowing time did not affect yield for the two winter varieties, SF Edimax CL and Hyola® 970CL with a >4.0 t/ha yield from all sowing dates. The yield for the slowest developing spring variety (Victory® V7001 CL) was also unaffected by sowing time, but did not achieve more than 3.6 t/ha from any sowing date. Yields from all five remaining spring varieties were significantly affected by sowing date with yield increasing as sowing date was delayed.

Sowing time also affected grains per pod. All spring varieties had an increase in grains per pod as sowing was delayed, while both winter varieties demonstrated a decrease in grains per pod as sowing was delayed.

The major frosts in 2017 occurred when all the spring varieties were susceptible to some level of frost damage. Assessing the proportion of viable seeds per pod provided a measure for the damage. Frost damage was greatest in early-flowering varieties, especially early-sown fast-developing varieties such as Nuseed® Diamond, ATR Bonito^{db} and Pioneer® 44Y90 (CL). These varieties should not be sown before mid April and still yielded very well when sown in early May. The winter varieties flowered after the frosts of winter and generally had a lower proportion of viable seeds per pod as sowing time was delayed.

The performance of the winter varieties Hyola® 970CL and SF Edimax CL showed potential for these varieties for early sowing canola in south-western NSW irrigation regions. There was a heat stress event of 37 °C on 23 September when these varieties were flowering, but grain yield was still very high.

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