Effect of sowing date on phenology and grain yield of twelve canola varieties – Canowindra 2015

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Key findings

» Early sowing exacerbated phenological differences between the varieties.

» The spread of days to reach 50% flowering within each time of sowing (TOS) varied by 35, 26 and 14 days in TOS 1, TOS 2 and TOS 3 respectively.

» The highest yield was achieved by Nuseed GT-50 (3.59 t/ha) sown on 1 May.

» Hyola® 600RR was the highest yielding variety when averaged across all sowing dates.

» The sowing time had a negligible impact on grain yield.

» The biomass at 50% flowering was greatest in TOS 2 (9.92 t/ha) followed by TOS 1 (7.93 t/ha) and TOS 3 (9.23 t/ha).

» There was a strong correlation between biomass at maturity and grain yield, i.e. a higher biomass produced a higher yield.

Introduction

Sowing dates in the high rainfall zones of central and southern NSW have slowly shifted earlier in recent seasons. Crop modelling (Lilley et al. 2015) and some early field experiments from the Optimised Canola Profitability project have indicated that there are potential grain yield increases from sowing earlier than the traditional date of 25 April, provided the appropriate varietal management is used.

This experiment evaluated the effect of sowing date on phenology and grain yield of 12 canola varieties ranging from long- to short-season phenology types.

Site details

Location	Canowindra, NSW
Soil type	Red chromosol
Previous crop	Wheat
Stubble management	Burnt
Fertiliser	83 kg/ha Gran-Am predrilled, 130 kg/ha urea predrilled and 68 kg/ha MAP banded at sowing
Soil pH_{Ca}	4.6
Colwell P 0–10 cm (mg/kg)	66
Mineral nitrogen (N) (0–1.8 m)	104 kg N/ha
Plant-available water at sowing	100 mm
Frosts (July–September) 16 events	3/6, 4/6, 21/6, 29/6, 3/7, 4/7, 5/7,6/7, 8/7, 9/7,19/7, 29/7, 4/8,9/8, 19/8, 30/8

Monthly rainfall at experiment site													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
2015	76	34	10	42	23	26	70	86	0	19	61	45	492
LTA	59	52	45	43	44	52	50	50	46	56	51	53	601

*LTA = long-term average

Treatments

12 canola varieties	Pioneer® 44Y89 (CL) Pioneer® 45Y88 (CL) ATR Gem$^{\phi}$ ATR Stingray$^{\phi}$ AV Garnet$^{\phi}$ Nuseed GT-50	Hyola® 559TT Hyola® 575CL Hyola® 577CL Hyola® 600RR Hyola® 750TT IH30 RR
Sowing dates	TOS 1: 2 April TOS 2: 15 April TOS 3: 1 May	

Results

The TOS 1 (2 April) and TOS 2 (15 April) treatments required irrigation with drip tape (equal to 12 mm rainfall) to establish. The TOS 3 (1 May) treatment did not require supplementary irrigation for establishment. Plant establishment was 32, 37 and 38 plants/m^2 for TOS 1, TOS 2 and TOS 3 respectively.

The experiment had ideal conditions for crop growth during winter with above average rainfall for April–August (247 mm). However, spring was relatively dry with no rain during September and above average temperatures during October.

Flowering date

The flowering date (50% of plants have one open flower) varied from 30 June to 30 August and was significantly affected by time of sowing (P <0.001), variety (P <0.001) and the time of sowing by variety interaction (P <0.001) (Table 1).

Flowering occurred on 19 July, 8 August and 25 August for TOS 1, TOS 2 and TOS 3 respectively when averaged across all 12 varieties.

The three fastest maturing varieties (shortest time to reach 50% flowering) were IH30 RR, ATR Stingray and Hyola® 575CL. The slowest maturing varieties were Hyola® 577CL, Hyola® 750TT and Hyola® 600RR.

The phenological difference between varieties significantly reduced as sowing was delayed. The spread of days to reach 50% flowering within each TOS was 35, 26 and 14 days for TOS 1, TOS 2 and TOS 3 respectively. In TOS 1, the quicker developing variety IH30 RR reached 50% flowering on 30 June compared with 4 August (35 days) for the slower developing variety Hyola® 577CL. However, in TOS 3 the difference in flowering date between IH30 RR and Hyola® 577CL was reduced, with 50% flowering occurring on 16 August and 30 August (14 days) respectively.

Dry matter at 50% flowering

Dry matter at 50% flowering ranged from 5.0 t/ha to 11.7 t/ha and was significantly affected by sowing time (P = 0.009), variety (P <0.001) and the interaction between sowing time and variety (P <0.001). Biomass accumulation at 50% flowering was greatest at TOS 2 (9.92 t/ha) compared with TOS 1 (7.93 t/ha) or TOS 3 (9.23 t/ha).

Biomass at 50% flowering increased as sowing was delayed in the faster developing varieties such as ATR Stingray, with an additional 1.0 t/ha and 2.1 t/ha produced from TOS 2 and TOS 3

Table 1. Grain yield, dry matter (DM) and flowering date at the experiment site near Canowindra, 2015.

Variety	Phenology	50% flowering date [a]			Dry matter at flowering (t/ha)			Grain yield (t/ha)		
		TOS 1 2 Apr	TOS 2 15 Apr	TOS 3 1 May	TOS 1 2 Apr	TOS 2 15 Apr	TOS 3 1 May	TOS 1 2 Apr	TOS 2 15 Apr	TOS 3 1 May
44Y89 (CL)	Mid	14 Jul	4 Aug	24 Aug	6.7	9.9	9.9	3.43	3.29	3.08
45Y88 (CL)	Long	26 Jul	13 Aug	29 Aug	9.4	10.8	9.0	3.35	3.08	2.90
ATR Gem	Mid	10 Jul	9 Aug	29 Aug	5.2	8.0	7.2	2.51	2.79	2.42
ATR Stingray	Short	5 Jul	23 Jul	17 Aug	5.0	6.0	7.1	2.66	2.70	2.38
AV Garnet	Mid	23 Jul	3 Aug	25 Aug	7.0	9.6	10.2	3.01	3.25	3.36
Nuseed GT-50	Mid	22 Jul	8 Aug	25 Aug	9.7	10.4	10.9	3.14	3.18	3.59
Hyola 559TT	Mid	23 Jul	11 Aug	25 Aug	7.6	10.3	9.5	2.31	3.21	2.75
Hyola 575CL	Short	6 Jul	4 Aug	25 Aug	6.4	10.4	11.1	3.02	2.98	2.99
Hyola 577CL	Long	6 Aug	15 Aug	30 Aug	10.1	11.4	9.6	2.92	3.31	3.10
Hyola 600RR	Long	31 Jul	14 Aug	28 Aug	11.2	11.8	9.6	3.40	3.23	3.52
Hyola 750TT	Long	4 Aug	18 Aug	30 Aug	10.6	11.7	7.9	2.40	3.23	2.78
IH30 RR	Short	30 Jun	31 Jul	16 Aug	6.1	9.0	9.1	3.36	2.97	3.05
	min	30 Jun	23 Jul	16 Aug	5.0	6.0	7.1	2.31	2.70	2.38
	mean	19 Jul	8 Aug	25 Aug	7.9	9.9	9.2	2.96	3.10	2.99
	max	6 Aug	18 Aug	30 Aug	11.2	11.8	11.1	3.43	3.31	3.59
P = 0.05	<0.001	<0.001	0.02							
5% l.s.d.	7 days	2.01 t/ha	0.49 t/ha							
a = flowering date was measured when 50% of plants had one open flower.										

respectively, compared with TOS 1. Conversely, the longer-season varieties achieved greatest biomass accumulation from TOS 1 and TOS 2, e.g. Hyola® 750TT had a biomass of 10.6, 11.7 and 7.9 t/ha at TOS 1, TOS 2 and TOS 3 respectively.

Grain yield

Grain yield was significantly affected by the time of sowing (P = 0.040) despite the yield only varying by 0.14 t/ha. Grain yield was also affected by variety (P <0.001) and the interaction between time of sowing and variety (P = 0.018). The water use efficiency of all treatments was 6–16 kg/mm (data not shown).

The highest grain yield was achieved from Nuseed GT-50 sown on 1 May (3.59 t/ha) and the lowest from ATR Stingray sown on 1 May (2.38 t/ha). Varieties that performed above average across all sowing dates were Pioneer® 44Y89 (CL), AV Garnet, Nuseed GT-50 and Hyola® 600RR.

There was no relationship between biomass at flowering and grain yield (R^2 = 0.06). In TOS 1, IH30 RR produced a grain yield of 3.36 t/ha from a dry matter of 6.1 t/ha while Hyola® 600RR yielded 3.40 t/ha from a biomass of 11.2 t/ha. However, there was a strong relationship between biomass at maturity and grain yield (greater maturity biomass produced higher yields) (Figure 1). In this experiment there was significant biomass produced during the post-flowering period.

Summary

This experiment highlighted large differences in phenology between varieties sown at three sowing dates and demonstrated how these differences are exacerbated if sowing is brought forward to early April.

Seasonal conditions and management will ultimately influence when canola is sown on a year to year basis. However, these results give growers the information required to select the appropriate variety to capitalise on early sowing opportunities that still enable flowering to occur during the optimum period (mid-August to late-September) to minimise frost risk. More research is required to understand the relationship between critical phases of biomass accumulation and grain yield across a range of seasonal conditions.

Reference

Lilley, J, Bell, L & Kirkegaard, J 2015, 'Optimising grain yield and grazing potential of crops across Australia's high rainfall zone: a simulation analysis', *Crop and Pasture Science*, vol. 66, pp. 349–364.

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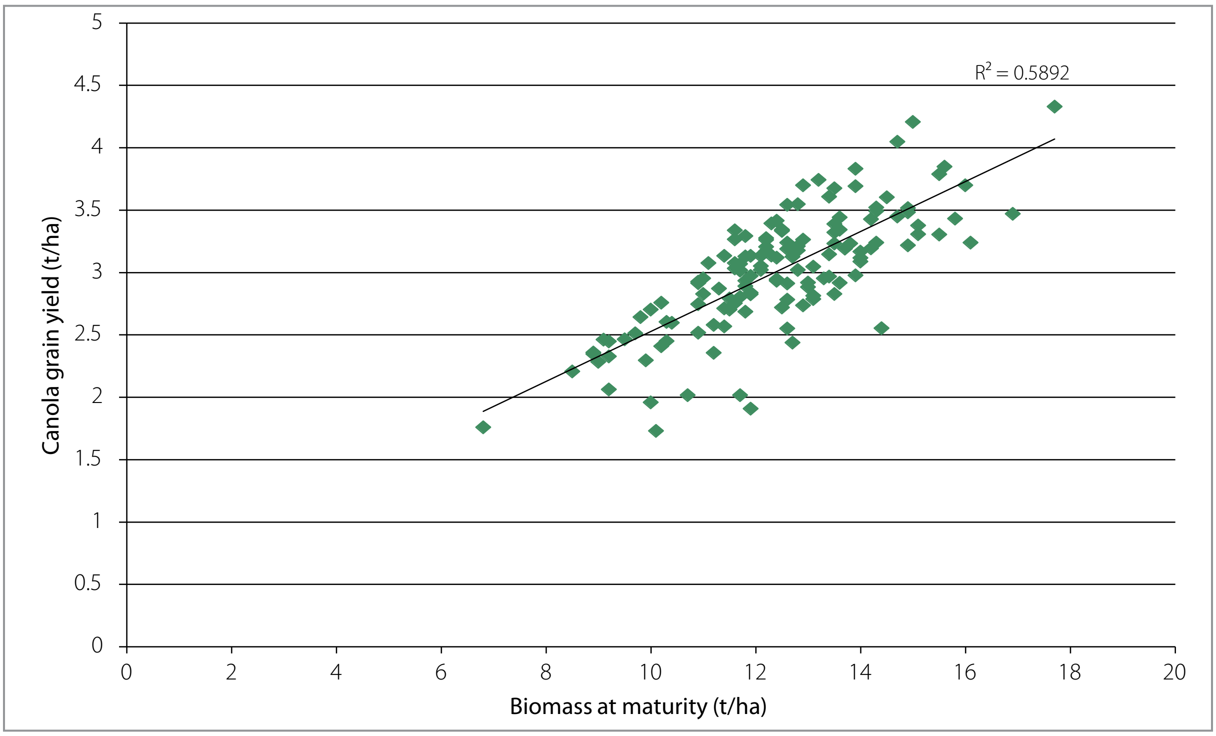

Figure 1. The relationship between grain yield and biomass of canola at maturity, Canowindra 2015.