Can we extend the sowing window of canola in WA: #2 Wongan Hills

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Key messages

- Yield were impressive; 1.9t/ha from April 26 and 2.2t/ha from May 17.
- Mid-season maturity varieties showed the greatest plasticity in plant development across sowing dates and may be a good option over a wide sowing/establishment period.
- Short season hybrids may enable the sowing window to be extended later with reduced risk.
- Long season varieties yielded poorly from these sowing dates.

Background

There is considerable interest in sowing canola early to maximise yield and minimise the risk of missing a sowing opportunity (Harries 2016). Traditionally ANZAC day marked the date on which growers would start dry seeding. However, now growers are routinely sowing in mid-April and are prepared to sow around the first week of April if there is rain at that time (Fletcher et al 2016).

For the past 120 years, since the release of Federation wheat, plant breeding programs of all crop species have focused on increasingly short season varieties with high harvest index (Pugsley 1983). More recently longer wheat genotypes are being explored (Hunt 2017), because these may be better adapted to earlier sowing. The same needs to occur with broadleaf species by testing current varieties at a wide range of sowing dates and comparing these to diverse phenotypes.

Aims

To investigate yield and phenology of canola varieties when sown in March to provide better advice to agronomists and growers about the best varieties to use and safe sowing and flowering windows.

Method

The trial was conducted in 2018 at the Department of Primary Industries and Regional Development's Wongan Hills Research Station, on a deep sand over gravel. Plots were 10m long by 1.54m wide. Treatments included 11 varieties and four times of sowing (TOS) (March 15, April 5, April 26 and May 17). The varieties were all Triazine Tolerant (TT) and included both open pollinated and hybrid plant types of a wide range of season lengths: CBTelfer (V.Early), ATR Stingray (Early), ATR Bonito (Early/mid), ATR Wahoo (Late), Hyola 350TT(V.early) Bayer InVigor T4510 (Early), Pioneer 44TO2 (Early), Hyola 559TT (Mid), SF Ignite (Mid/late), DG 670TT (Late), Hyola 725RT (Late). Varieties were blocked within times of sowing and there were 4 replicates.

Measurements included: plant density, Normalised Difference Vegetation Index (NDVI), ground cover, flowering dates, plant biomass near maturity, seed yield, seed oil content and seed weight. The seed rate used for each variety was calculated for a target density of 40 plants/m^2 at an expected field establishment rate of 65%.

Irrigation was applied for establishment and to ensure survival of seedlings in the dry conditions from mid-March to May 23. Consequently more irrigation was required for earlier sowing dates: TOS 1, 2, 3, and 4 received 40, 30, 30 and 15mm respectively.

Results

Seasonal conditions

Rainfall at the site from March 15 to October 31 was 285mm and 51mm had been received prior to TOS 1. Total growing season rainfall plus irrigation was 295, 286, 289 and 300mm for TOS 1, 2, 3 and 4 respectively.

Table 1. Rainfall (mm) at Wongan Hills Research Station 2018

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Site	44	3	3	0	33	50	79	88	8	30	14	4	359

Soil moisture

Soil moisture increased with depth and was similar for each sowing time, consistent with lack of rainfall to May 23. Prior to sowing on March 15 gravimetric water content was: 5.1, 5.0, 5.5, 6.2 and 7.8% at 0-10, 10-20, 20-30, 30-50 and 50-90 cm respectively.

Soil and air temperature

Maximum air temperature peaked above 30°C from mid-March to mid-May (Figure 1) and maximum surface soil temperature exceeded 30 degrees from mid-March to early April (Figure 2a). After the first week of April sub-soil temperatures declined from around 25°C (Figure 2b). Air temperature dropped below 0°C in mid-September. Soil temperature at soil depths of 10 and 50 cm dropped below 15 °C from June to mid-September.

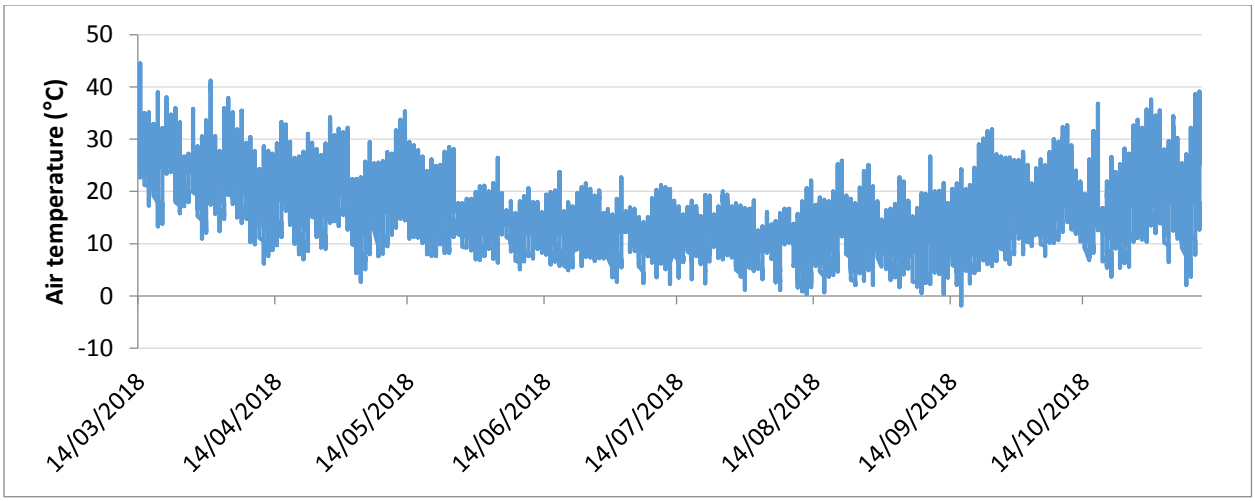


Figure 1. Air temperature measured hourly at canopy height, (°C)

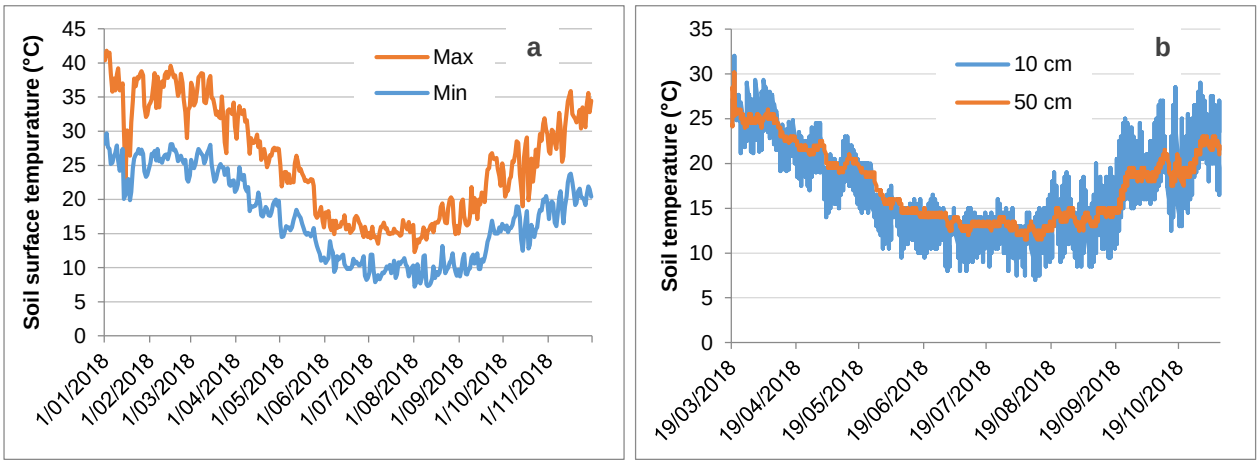


Figure 2. Soil temperatures at Wongan Hills Research station 2018. Surface daily, 10 and 50cm, 3 hourly (°C).

Establishment and growth

Overall plant establishment was on target at 40 plants/m^2 and 65% field establishment (FE). There was a significant TOS response, (P <0.05). From TOS 4 there were more plants per square metre than the other three sowing times; 55 plants/m^2 (88% FE) compared to 41 plants/m^2 (66% FE), 32 plants/m^2 (52% FE) and 31 plants/m^2 (51% FE) for TOS 1, 2 and 3 respectively. There was also a difference (P <0.001) in establishment of the varieties, despite all plots receiving 948 viable seeds. The range between varieties was 36 plants/m^2 to 45 plants/m^2 with CBTelfer and Hyola 725RT producing the lowest densities (Figure 3a). Seed of these varieties was a few years old because it was not available for purchase. ATR Stingray also had low plant density and this was consistent across all 3 trial sites in this trial series. There was no statistical interaction of TOS and variety. Field establishment was not related to seed size at any sowing date (data not presented).

Plant growth was measured as green plant area using NDVI at several dates. In early June there was a large difference in green area between the sowing times (P <0.001). Time of sowing 1 and 2 had more green area than times 3 and 4, this was despite TOS 1 flowering and already declining in green area. There was considerable difference between varieties but this was not statistically significant (Figure 3b).

Biomass at maturity increased at later sowing times and was significantly different between sowing times 1&2 and 3&4 (Table 2). The final biomass cuts included seed and as such the bird damage that occurred within TOS 1&2 will have affected these results. Even so there were clear varietal differences (P <0.001) and a variety by sowing time interaction (P <0.001). It is notable that the early season hybrids were able to produce large amounts of biomass which indicates that they are quite plastic in their growth habit.

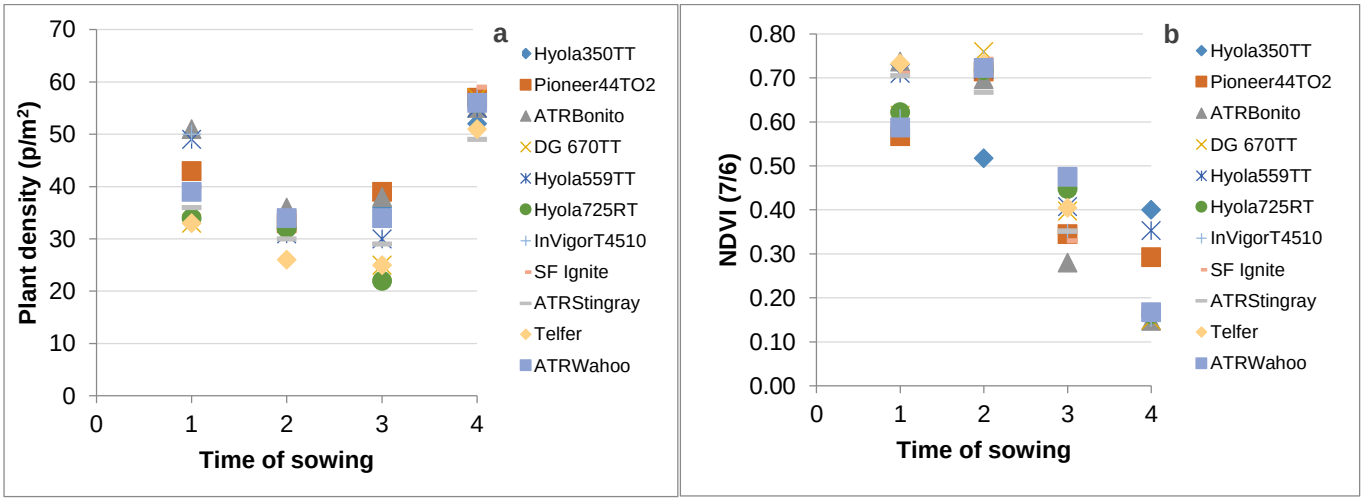


Figure 3. Field establishment (plants/m^2) and green area measured as NDVI of 11 canola cultivars from time of sowing 1 (March 15), 2 (April 5), 3 (April 26) and 4 (May 17) at Wongan Hills in 2018.

Table 2. Plant biomass at maturity (g/m^2). TOS 1 sampled September 19, TOS 2 & 3 September 26, TOS 4 (October 10)

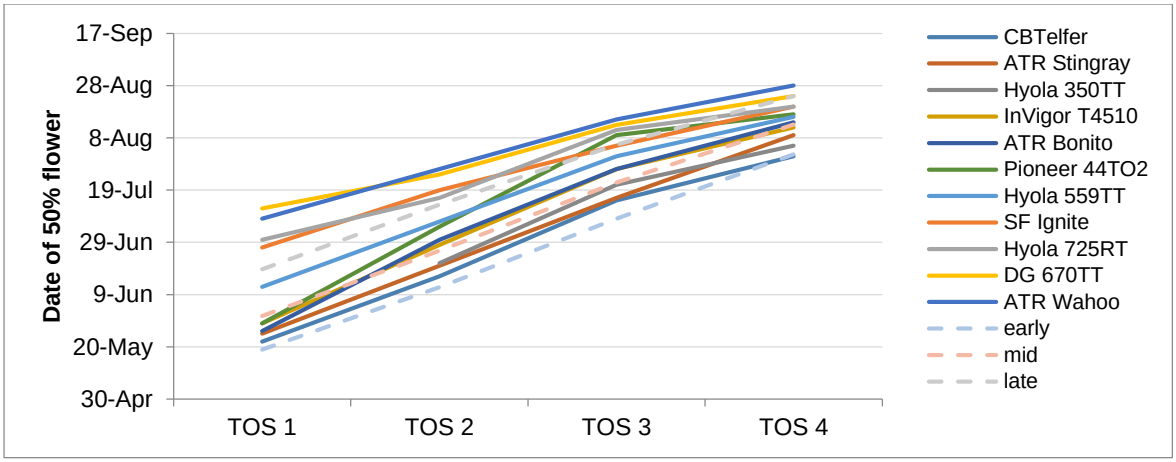
	Biomass (g/m^2)				
Variety	TOS 1	TOS 2	TOS 3	TOS 4	Var Av
Hyola 350TT		455	664	802	640
Pioneer 44TO2	460	618	581	779	610
ATR Bonito	304	366	627	693	497
DG 670TT	435	543	779	702	615
Hyola 559TT	469	468	604	825	591
Hyola 725RT	625	656	638	769	672
InVigor T4510	376	430	694	792	573
SF Ignite	533	541	625	796	624
ATR Stingray	365	401	657	618	510
CB Telfer	585	462	624	612	571
ATR Wahoo	543	666	645	619	618
TOS Av	469	510	649	728	
F prob TOS	<0.05				
Lsd	120				
F prob Var	<0.001				
Lsd	68				
F prob interaction	<0.001				
Lsd	154				

Development

Flowering on the main stem was measured from the same 20 plants per plot throughout the experiment. Later sowing had the effect of reducing the differences in flowering time of the varieties, as would be expected to occur in response to reduced growing period. From TOS 1 the earliest varieties reached 50% of plants with flowers on the main stem by May 22 (68 DAS) and latest varieties reached this stage on July 12 (119 DAS), such that there was 51 days difference between them. For TOS 4 the earliest varieties reached 50% of plants with flowers on the main stem by August 1 (76 DAS) and latest varieties reached this stage on August 28 (103 DAS), such that there was 27 days difference between them (Figure 5). The duration of flowering of the whole plant was estimated by rating the percentage bloom from whole plots. Flowering duration from TOS 1 ranged across varieties from 100 to 74 days. This compared to 46 to 52 days for TOS 4. Hence later sowing had the effect of reducing the whole plant flowering duration and reducing the difference in flowering duration between varieties. The mid-season varieties had the greatest plasticity of plant development across sowing times, with up to 51 days difference in flowering duration between TOS 1 and 4 (Table 2).

As with all trials in this series the recently released early season hybrids including, Hyola 350TT, InVigor T4510 and Pioneer 44TO2 all flowered earlier than Hyola 559TT.

APSIM predictions of flowering date were reasonable (Figure 5), although the range of 50% flowering dates was greater at TOS1 from observations. APSIM results are discussed further in (Farre et al 2019).



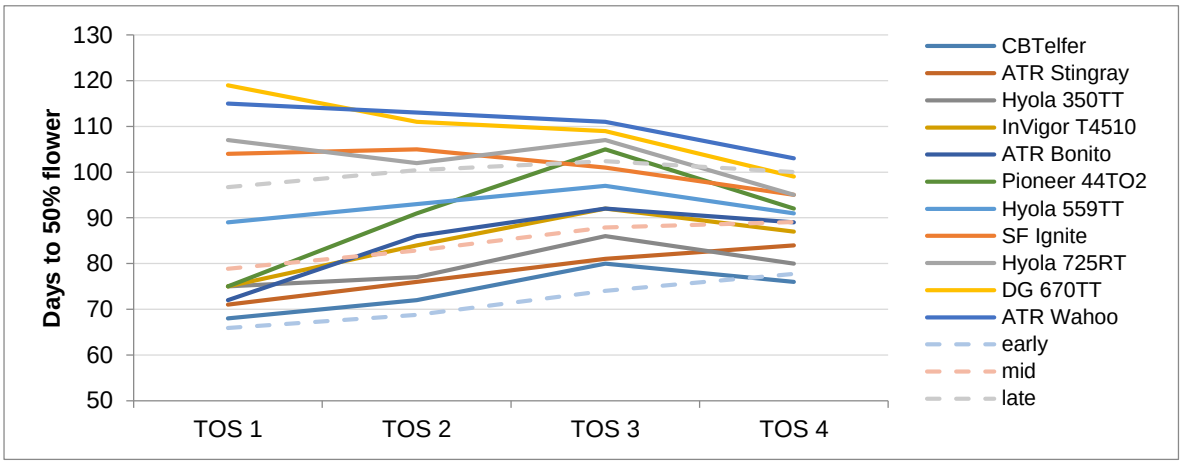


Figure 5. Flowering on main stem; dates and days from seeding for 11 canola varieties, and simulated APSIM dates for 3 canola maturity groups, from time of sowing 1 (March 15), 2 (April 5), 3 (April 26) and 4 (May 17) at Wongan Hills in 2018.

Table 2. Whole plot ratings of bloom, dates at first and last 10% of bloom and duration between these dates.

	TOS 1			TOS 2			TOS 3			TOS 4			
Variety	First 10%	Last 10%	Days	First 10%	Last 10%	Days	First 10%	Last 10%	Days	First 10%	Last 10%	Days	Days difference TOS 1 to TOS 4
ATR Stingray	14/5	10/8	88	10/6	22/8	73	15/7	19/9	66	3/8	22/9	50	38
Hyola 350TT				8/6	24/8	77	12/7	17/9	67	1/8	22/9	52	
InVigor T4510	16/5	9/8	85	8/6	5/9	89	22/7	19/9	59	9/8	24/9	46	39
ATR Bonito	17/5	8/8	83	15/6	30/8	76	20/7	15/9	57	8/8	24/9	47	36
Pioneer 44TO2	26/5	26/8	92	21/6	12/9	83	20/7	17/9	59	7/8	25/9	49	43
Hyola 559TT	24/5	25/8	93	24/6	13/9	81	25/7	19/9	56	8/8	27/9	50	43
DG 670TT	30/5	25/8	87	4/7	5/9	63	28/7	22/9	56	12/8	1/10	50	37
SF Ignite	7/6	15/9	100	4/7	16/9	74	26/7	22/9	58	14/8	2/10	49	51
Hyola 725RT	22/6	16/9	86	10/7	25/9	77	28/7	27/9	61	15/8	4/10	50	36
ATR Wahoo	25/6	7/9	74	10/7	25/9	77	12/8	23/9	42	20/8	5/10	46	28

Note: CBTelfer not reported as bird damage affected flowering duration &, Hyola 350TT not available for TOS 1.

Yield and quality

Yield and quality data is presented from TOS 3 and 4 only because of bird damage to earlier sown treatments.

The overall yield of the trial was 2043 kg/ha. Averaged across all varieties TOS 3 yielded 1940 kg/ha and TOS 4, 2146 kg/ha. The higher yield from sowing in May compared to April was most likely due to mild spring conditions, however the difference was not statistically significant. There was a variety response with CBTelfer, ATR Wahoo and Hyola 725RT yielding less than all of the other varieties; these varieties are the extremes of short (CBTelfer) and long (ATR Wahoo & Hyola 725RT) season types included in the trial. All varieties except Hyola 725RT yielded more from the later sowing date (TOS 4) and there was no variety by sowing time interaction (Figure 6).

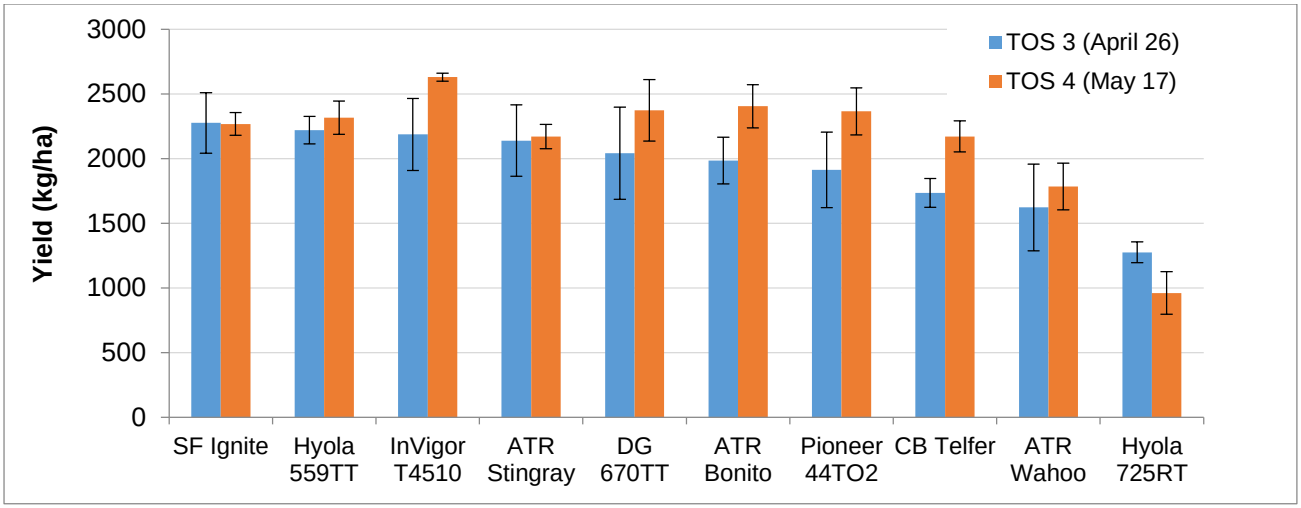


Figure 6. Seed yield of 10 canola varieties from time of sowing 3 (April 26) and 4 (May 17) at Wongan Hills in 2018.
Note: Hyola 350TT not reported due to bird damage.

Time of sowing did not affect seed oil or seed size but variety affected both (Table 2). Seed oil concentration of varieties ranged from 47.1 to 44.4%, this represents a $21/tonne difference between varieties (Table 3).

Table 3. Seed oil concentration (%) and 1000 seed weight (g).

	Seed oil (%)			1000 seed weight		
Variety	TOS 3	TOS 4	Var Av.	TOS 3	TOS 4	Var Av.
Hyola 350TT	44.5	44.2	44.3	3.9	3.5	3.7
Pioneer 44TO2	45.5	44.5	45.0	3.5	3.2	3.3
ATR Bonito	47.6	46.6	47.1	3.7	3.1	3.4
DG 670TT	44.9	44.1	44.5	3.2	3.0	3.1
Hyola 559TT	47.4	45.2	46.3	3.7	3.3	3.5
Hyola 725TT	46.9	44.8	45.8	3.5	3.5	3.5
InVigor T4510	45.4	44.7	45.1	3.4	3.1	3.2
SF Ignite	44.6	44.1	44.4	3.1	3.0	3.1
ATR Stingray	46.7	44.3	45.5	3.0	2.6	2.8
CB Telfer	46.7	45.1	45.9	3.4	3.2	3.3
ATR Wahoo	45.3	43.7	44.5	3.3	3.4	3.4
TOS average	46.0	44.7		3.4	3.2	
F prob TOS	NS			NS		
Lsd						
F prob Var	<0.001			<0.001		
Lsd	1.07			0.1827		
F prob interaction	NS			NS		

Conclusions

There are a wide range of maturity types within existing canola cultivars. The mid-season maturity varieties showed the greatest plasticity in plant development across the sowing dates and may be a good option over a wide sowing period. Short season hybrids produced substantial biomass from later sowing dates and may enable the sowing window to be extended later with reduced risk. Both of these traits would be particularly useful in dry sowing situations when emergence date is unknown.

Key words; Canola, Sowing time, Variety

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