Can we extend the sowing window of canola in WA: #1 Tenindewa

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Key messages

- Overall yield from May 17 sowing was impressive for this AgZone, at 1.6 t/ha.
- Delayed sowing by 34 days, to June 20, led to 1042 kg/ha less yield – 30 kg/ha/day.
- Short season hybrids could extend the safe sowing window later in this environment.
- Difficulty establishing canola in hot conditions could limit how far the sowing window can be brought forward.
- To take advantage of early autumn rains in this environment larger seeded broadleaf species that can be sown deeper should be tested.

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 Tenindewa, 18km west of Mullewa on a red loamy sand. Plots were 12m long by 1.54m wide. Treatments included 11 varieties and five times of sowing (TOS) (March 15, April 5, April 26, May 17 and June 20). The varieties were all Triazine Tolerant 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), 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%.

30mm of irrigation was applied prior to each of the first 4 sowing dates and this was followed 3-4 days after with a further 5mm.

Results

Seasonal conditions

Annual rainfall at the site was 239mm and 47mm had been received from January prior to sowing of TOS 1.

The first rains of the season occurred late, on May 22. Regular rain was received throughout the growing period until September. As such irrigation was required to seed the first four sowing times. Six days after the 4th sowing time, May 17, there was over 40mm of rain. There was 79mm of rain between May 17 and June 20, the 4th and 5th sowing times.

Table 1. Rainfall (mm) at trial site.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Site	45	2	0	0	19	48	73	38	5	10	8	0	247

Soil moisture

Soil moisture was similar for each sowing time apart from TOS 5, reflecting the lack of rainfall through to May 23. Surface 0-10cm gravimetric water content ranged from 5.0 to 5.3% across sowing dates. There was substantial stored soil moisture at depth ranging from 6.5 to 8.0% at 90 cm, data not presented.

Soil and air temperature

Maximum air temperature (Figure 1) and soil surface temperature (Figure 2) exceeded 40°C from late March to mid-April. After the first week of April sub-soil temperatures (Figure 2) declined from close to 30°C to 25°C. Soil moisture in the top few centimetres of soil was not measured, however high temperatures and the seeding process caused the top 3-4cm of soil to dry rapidly after the first three sowing dates, March 15, April 5 and April 26.

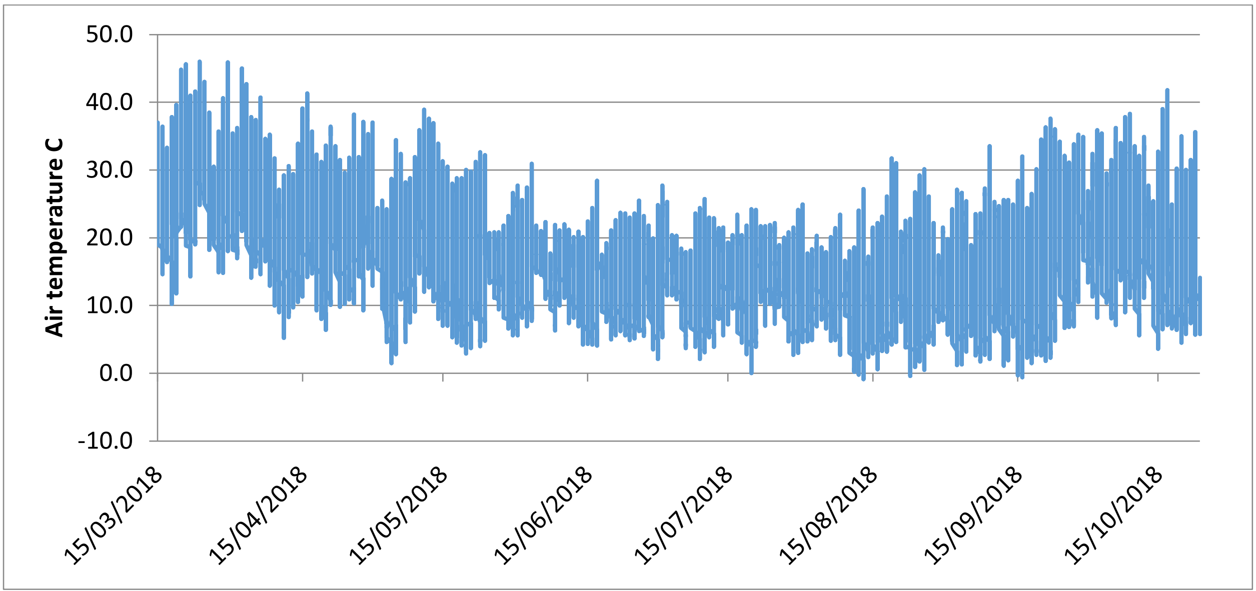

Figure 1. Air temperature measured hourly at canopy height (°C)

Soil temperature

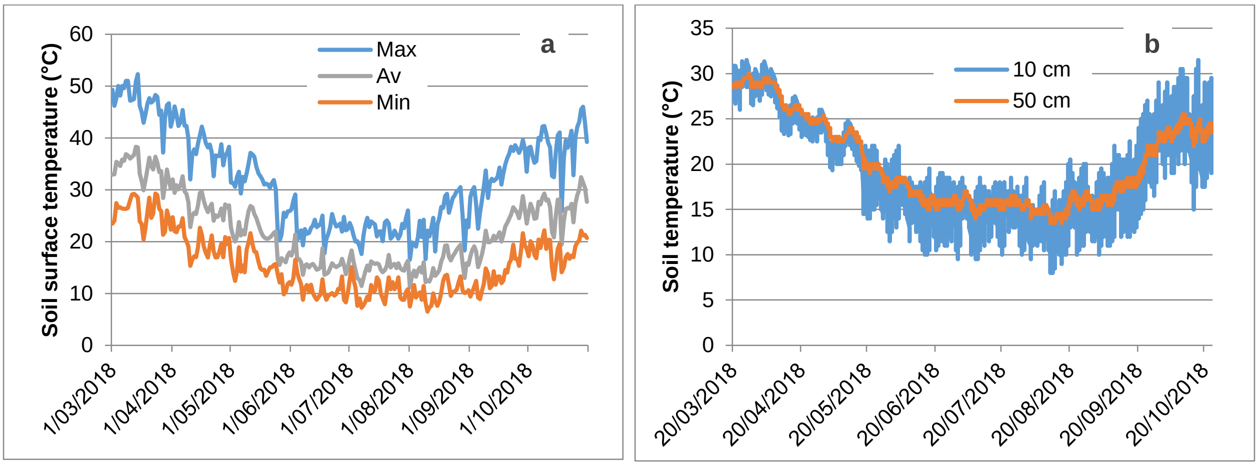

Figure 2. Soil temperatures at the Tenindewa field site, 2018. Surface daily, 10 and 50cm, 3 hourly (°C).

Establishment and growth

Plants did not establish from TOS 1 and few plants established from TOS 2 and 3 due to the hot drying soil conditions. Field establishment was 0.1%, 12% and 5% for TOS 1, 2 and 3 respectively. For all of these sowing times almost no seedlings emerged after the May 23 rain. This indicates seedlings may have sprouted but not emerged (as was observed) or seed had been sterilised in the hot drying soil conditions. There are no further observations reported for these three sowing times. Interestingly APSIM did not account for this seed kill and predicted 1.5 t/ha from March sowing on 10mm of irrigation. Time of sowing 4 and 5 had on average 16 and 22 plants/m^2 respectively, significantly more in TOS 5. This translates to 30% field establishment for TOS 4 and 42% for TOS 5 (Table 2). Larger seeded varieties tended to have a higher field establishment at sowing time 4, under difficult establishment conditions, but not in the better establishment conditions of TOS 5 (Figure 3). Green area, measured as NDVI on July 27 was significantly greater for TOS 4 than TOS 5. There was a significant difference between varieties and a significant variety by TOS interaction, but this was not associated with variety season length (Table 2).

Table 2. Plant density (p/m^2), field establishment (%) and normalised difference vegetation index (NDVI) of 11 canola varieties sown on either May 17 (TOS 4) or June 20 (TOS 5) at Tenindewa in 2018.

	Plant density (p/m^2)			Field establishment (%)			NDVI 27/7		
Variety	**TOS 4**	**TOS 5**	**Var Av.**	**TOS 4**	**TOS 5**	**Var Av.**	**TOS 4**	**TOS 5**	**Var Av.**
Pioneer 44TO2	20	26	23	38	50	44	0.473	0.128	0.300
ATR Bonito	18	23	20	34	43	38	0.453	0.130	0.291
DG 670TT	14	19	16	27	35	31	0.505	0.108	0.306
Hyola 350TT	19	24	21	36	45	41	0.400	0.180	0.290
Hyola 559TT	16	22	19	30	42	36	0.503	0.155	0.329
Hyola 725RT	11	23	17	20	44	32	0.428	0.120	0.274
InVigor T4510	18	22	20	34	41	38	0.468	0.103	0.285
SF Ignite	15	23	19	28	43	35	0.485	0.080	0.283
ATR Stingray	14	28	21	27	54	40	0.385	0.095	0.240
CBTelfer	11	14	13	22	27	25	0.325	0.035	0.180
ATR Wahoo	16	22	19	31	42	37	0.488	0.110	0.299
TOS Average	16	22		30	42		0.446	0.113	
P value TOS	<0.001			<0.001			<0.001		
Lsd TOS	2.5			2.7			0.021		
P value VAR	<0.001			<0.001			<0.001		
Lsd VAR	1.5			6.7			0.050		
P Interaction	<0.05			<0.05			<0.05		
Lsd Interaction	5.0			9.5			0.071		

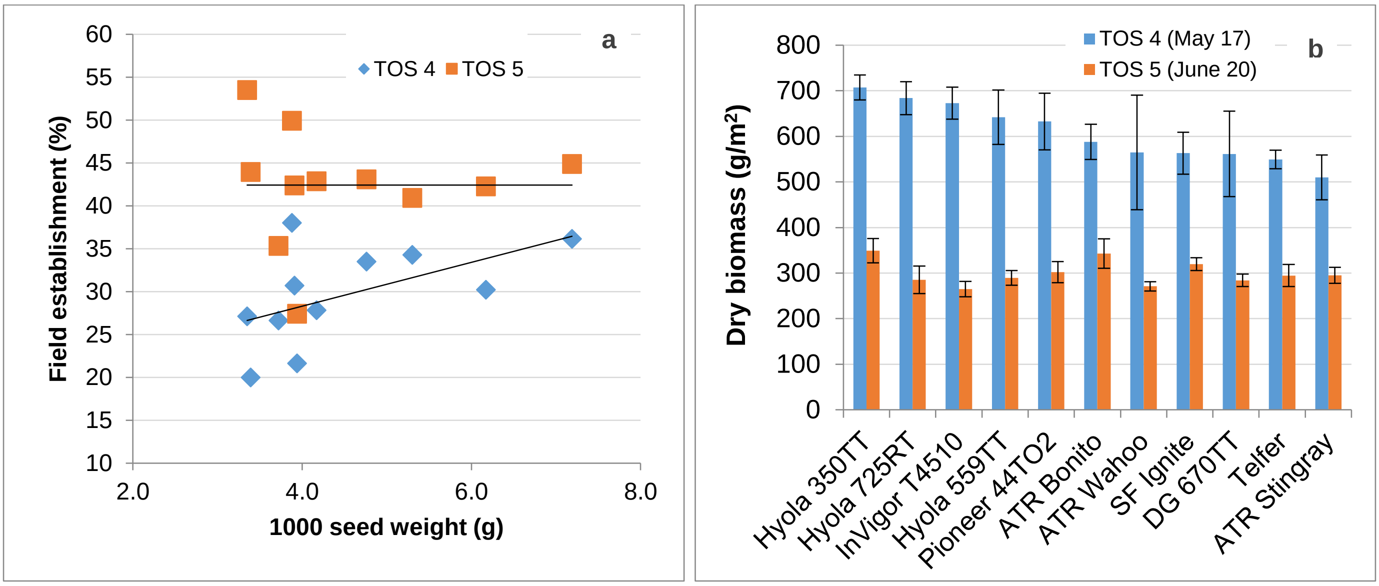

Figure 3. Field establishment and plant growth, measured on September 20– TOS 4 and October 4 – TOS 5, of 11 canola varieties sown on either May 17 (TOS 4) or June 20 (TOS 5) at Tenindewa in 2018.

Development

For the times of sowing that established (TOS 4&5), flowering was measured from the main stems of the same 20 plants per plot throughout the experiment (Table 3). The first plants from TOS 4 reached 10% flowering on June 6 compared to August 18 for TOS 5. There was a greater range of flowering dates between the varieties from TOS 4 than TOS 5. Hence 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. Consequently flowering duration was longer for the short season varieties when sown earlier but not for the mid and late season varieties. For example when sown in mid-May the recently released early season hybrids, Hyola 350TT, InVigor T4510 and Pioneer 44TO2 all had a considerably longer flowering duration than Hyola 559TT, which is classed as a mid-maturity variety (Table 3). This highlights that in this environment the most reliable way to extend flowering duration is a plant type that flowers early with the plasticity to continue flowering should conditions remain favourable. APSIM predicted flowering date and duration responses reasonably accurately at this site (Table 3), APSIM results are discussed further in (Farre et al 2019).

Table 3. Observed and modelled (APSIM) flowering data from Tenindewa in 2018 - Main stem flowering date and duration; days from sowing at which 10% of plants had first flowers, 50% had first flowers and 10% had last flowers.

	Date to flowering			Days to flowering			APSIM	
Variety	**10%**	**50%**	**10%**	**10%**	**50%**	**10%**	**50%**	**Flowering duration (days)**
				Sown May 17				
CB Telfer	12/6	9/7	17/8	26	53	92	15/7 (v. early)	66
Hyola 350TT	16/6	17/7	19/8	30	61	94		64
ATR Stingray	20/6	21/7	19/8	34	65	94		60
ATR Bonito	27/6	29/7	25/8	41	73	100	23/7 (early)	59
InVigor T4510	2/7	1/8	27/8	46	76	102		56
Pioneer 44TO2	26/6	30/7	27/8	40	74	102		62
Hyola 559TT	27/7	3/8	2/9	71	78	108	3/8 (mid)	37
DG 670TT	30/7	7/8	2/9	74	82	108		34
SF Ignite	1/8	6/8	3/9	76	81	109		33
Hyola 725RT	4/8	8/8	3/9	79	83	109		30
ATR Wahoo	6/8	10/8	3/9	81	85	109	18/8 (late)	28
				Sown June 20				
CB Telfer	18/8	29/8	28/9	59	70	100	19/8 (v.early)	41
Hyola 350TT	19/8	28/8	29/9	60	69	101		41
ATR Stingray	20/8	29/8	29/9	61	70	101		40
ATR Bonito	20/8	30/8	30/9	61	71	102	27/8 (early)	41
InVigor T4510	21/8	2/9	1/10	62	74	103		41
Pioneer 44TO2	21/8	2/9	1/10	62	74	103		41
Hyola 559TT	20/8	1/9	1/10	61	73	103	5/9 (mid)	42
DG 670TT	5/9	10/9	3/10	77	82	105		28
SF Ignite	27/8	9/9	3/10	68	81	105		37
Hyola 725RT	6/9	11/9	4/10	78	83	106		28
ATR Wahoo	7/9	14/9	5/10	79	86	107	16/9 (late)	28

Yield

The overall yield of the trial was 1035 kg/ha. Averaged across all varieties TOS 4 yielded 1556 kg/ha compared to 514 kg/ha for TOS 5. Hence delaying sowing by 34 days led to 1042 kg/ha less yield – equivalent to a loss of 30 kg/ha/day. In general, yields were well above what would be expected from these sowing dates and the result indicate strong breeding progress in the short season TT hybrid plant types (Figure 4).There was a variety response with the more recently released hybrids among the highest yielding varieties. Statistically the varieties could not be separated for response to sowing time. However when TOS 5 yields were transformed to per cent of TOS 4 yield there was a strong trend of short season varieties producing a higher percentage e.g. Hyola 350TT TOS 5 produced 47% of TOS 4 yield compared to the long season variety ATR Wahoo TOS 5 producing 16% of TOS 4. It is also interesting to note that the short season hybrids such as Hyola 350TT and InVigor T4510 produced more biomass than the short season OP's. APSIM simulated yields were close to observed with similar responses of maturity type to sowing time (Fig 4).

Seed quality

Averaged across all varieties there was a small but significant difference (P <0.001) in seed oil content; TOS 4, 42.1% and TOS 5, 41.3%. All varieties except ATR Stingray produced less oil from the June 20 sowing compared to the May 17. Varieties differed in oil content *(P <0.001)* ranging from 39.2% to 43.5% (Table 4), this represents a $30/tonne difference between varieties. Seed weight from TOS 4 seed was 110% the weight of TOS 5. There was significant variation among the varieties ranging from 2.7 to 3.3 g/1000 seed (Table 4).

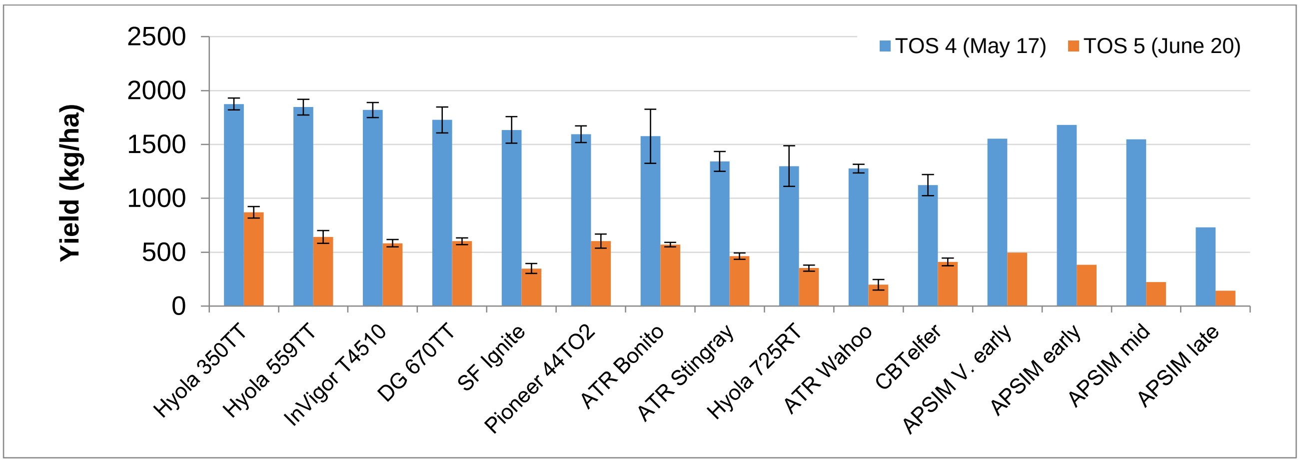

Figure 4. Seed yield (kg/ha) of 11 canola cultivars (and simulated APSIM yields for 4 canola maturity groups) sown on May 17 (TOS 4) or June 20 (TOS 5) at Tenindewa, 2018.

Table 4. Seed oil concentration (%) and 1000 seed weight (g).

	Seed oil (%)			1000 seed weight		
Variety	TOS 4	TOS 5	Var Av.	TOS 4	TOS 5	Var Av.
Pioneer 44TO2	42.5	41.9	42.2	2.9	2.8	2.9
ATR Bonito	43.7	43.2	43.5	3.2	3.1	3.1
DG 670TT	40.7	39.8	40.2	3.1	2.8	3.0
Hyola 350TT	42.5	41.6	42.0	3.1	2.7	2.9
Hyola 559TT	42.9	42.6	42.7	3.3	2.9	3.1
Hyola 725RT	42.6	42.4	42.5	3.3	3.2	3.2
InVigor T4510	41.6	39.7	40.6	3.2	2.8	3.0
SF Ignite	39.8	38.6	39.2	2.9	2.7	2.8
ATR Stingray	42.7	42.6	42.6	2.8	2.5	2.7
CBTelfer	41.8	42.5	42.1	3.2	2.8	3.0
ATR Wahoo	42.1	39.5	40.8	3.4	3.1	3.3
TOS Average	42.1	41.3		3.1	2.8	
P value TOS	<0.001			<0.001		
Lsd TOS	0.33			0.038		
P value VAR	<0.001			<0.001		
Lsd VAR	0.76			0.088		
P Interaction	<0.05			<0.05		
Lsd Interaction	1.08			0.13		

Conclusions

Overall yield from May 17 was impressive at 1556 kg/ha. This trial reinforces previous results showing timely seeding is critical in this environment with yields declining 30 kg/ha/day after mid-May.

An ideotype for this environment appears to be early flowering with plasticity in growth and flowering to continue to form yield while conditions are favourable.

The newer short season hybrids fit this ideotype and may extend the safe sowing window later. The highest yielding short season hybrids yielded up to 870 kg/ha when sown on June 20. If these yields can be consistently achieved from this sowing date it would reduce the risk associated with late sowing or dry sowing with late breaking seasons.

This trial demonstrated that high temperatures and rapid soil drying may limit how far the sowing window for canola can be brought forward in this environment.

To take advantage of early autumn rains we need to test other broadleaf species that can be sown deeper. This would require assessing the field establishment that can be expected of the different species. It would also require testing plant phenology responses and yield of each species from very early sowing dates.

Key words

Canola, time of sowing, variety

References

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