When to take advantage of early seeding opportunities for canola in WA

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Abstract
Many WA growers are considering planting canola earlier to make use of increasingly infrequent sowing opportunities and to fit in with cropping systems. This work was initiated to investigate benefits and disadvantages and explore how early is too early. Eight large field trials with 4-5 sowing times (March 19-June 11) were established over low and medium rainfall sites in the WA Agricultural region over two seasons (2019-2020). Plots were irrigated pre- seeding and as necessary for crop survival post-seeding. Highest yields and gross margins were generated from the first two sowing times on March 19 and April 8. Contributing factors to high yields with early sowing are likely to be reduced heat stress during flowering and reduced drought stress during podding, compared with traditional (April 30) sowing. Risk factors included poor establishment, crop-survival, frost at the end of flowering, predation and disease.

Keywords
Phenology

Introduction
Canola seeding has become progressively earlier during the last decade, and it is established that higher yields can be attained from mid-April sowing compared with the traditional Anzac day (25 April) sowing, (Harries and Seymour 2016). Many WA growers are considering even earlier sowing, primarily to take advantage of an existing seeding opportunity. This is likely to become an increasingly important driver, with climate change reducing the incidence of autumn rains. Also, seeding after early rain effectively increases the growing season rainfall and extends the growing season, which is important in the short growing season areas, like Mullewa. There is a lack of experimental data on sowing canola in WA before mid-April.

Method
Eight large field trials were established over the WA Agricultural region, in low rainfall sites at Mullewa, and Grass Patch (data not reported) and medium rainfall sites at Wongan Hills and Dale (near Beverley), over two seasons (2019-2020). The trials had five times of sowing (TOS), starting on March 18 (very early sowing), then three weekly intervals at April 8 (early sowing), April 29 ('traditional' sowing), May 20 and June 11(late sowing, 2019 only), standardised at all sites and both years.

The varieties were all Triazine Tolerant and included both open pollinated (OP) and hybrid plant types of a wide range of season lengths; early maturity hybrid, Hyola 350TT, early-mid varieties ATR Bonito (OP), and InVigor T4510 (hybrid), and longer maturity, varieties SF Ignite (mid-late hybrid) and ATR Wahoo (mid-late OP).

Seeding rate was calculated for a target density of 40 plants/m², with seeding rates near 2-3 kg/ha with the notable exception of the large seeded Hyola 350TT in 2019 with a seeding rate of 6.1 kg/ha. Hybrid seed costs were $25, $28 and $22/kg for Hyola 350TT, InVigor T4510 and SF Ignite, respectively. All OP seed was budgeted for replacement and seed treatment at $3/kg.

Field plots were 10 or 12m long with four replicates. Each experiment was a split-plot design with sowing time as main plot, and varieties completely randomised within sowing time blocks. Early sown plots were fenced and netted for protection from predation. Trials were monitored for phenology on a weekly basis, as well as standard assessments for density, crop height, biomass, harvest index, yield and oil.

Growing season rainfall was around 180mm at Mullewa, 240mm at Wongan Hills and 320mm at Dale, over both 2019 and 2020. Plots were irrigated pre- seeding to mimic a good early-break and as necessary for crop survival post-seeding, with different amounts of irrigation applied to TOS treatments. 2019 pre-seeding irrigation was generally 40 mm or less but post-seeding irrigation was higher than planned, up to 158 mm at Mullewa TOS 1 (March 180), as the season break was not until June 6. In 2020 pre-seeding irrigation was set to mimic the soil water from the historical 20% wettest years in each location, which was 40 mm for Wongan hills and Dale and 50 mm for Mullewa. Post-seeding irrigation was greatly reduced in 2020 and generally only required for TOS 1, apart from Mullewa, which used 70 ml for TOS 1 (March 18), in 12 small instalments and 43 mm for TOS 2.

Results

Phenology and growth

With very early sowing, (March 18) all the varieties flowered at an earlier date, the flowering period was extended and phenology differences between varieties were magnified, compared with traditional sowing at the end of April. For example, at Mullewa in 2019, early sown Hyola 350TT started flowering (10% bloom) on May 12, compared to July 4 for traditional sowing time, flowering extended over a longer period at 77 days for ATR Bonito early sown, compared with only 33 days for traditional sowing, and differences between varieties were magnified, with a six-week range between varieties for the date of 50% flowering, compared with three-week range for end of April seeding (Fig 1). There was a significant decline in flowering duration with each sowing time, in each trial. An extended flowering period has been shown to set a higher number of pods (Harries et al 2018) effectively setting a high yield potential.

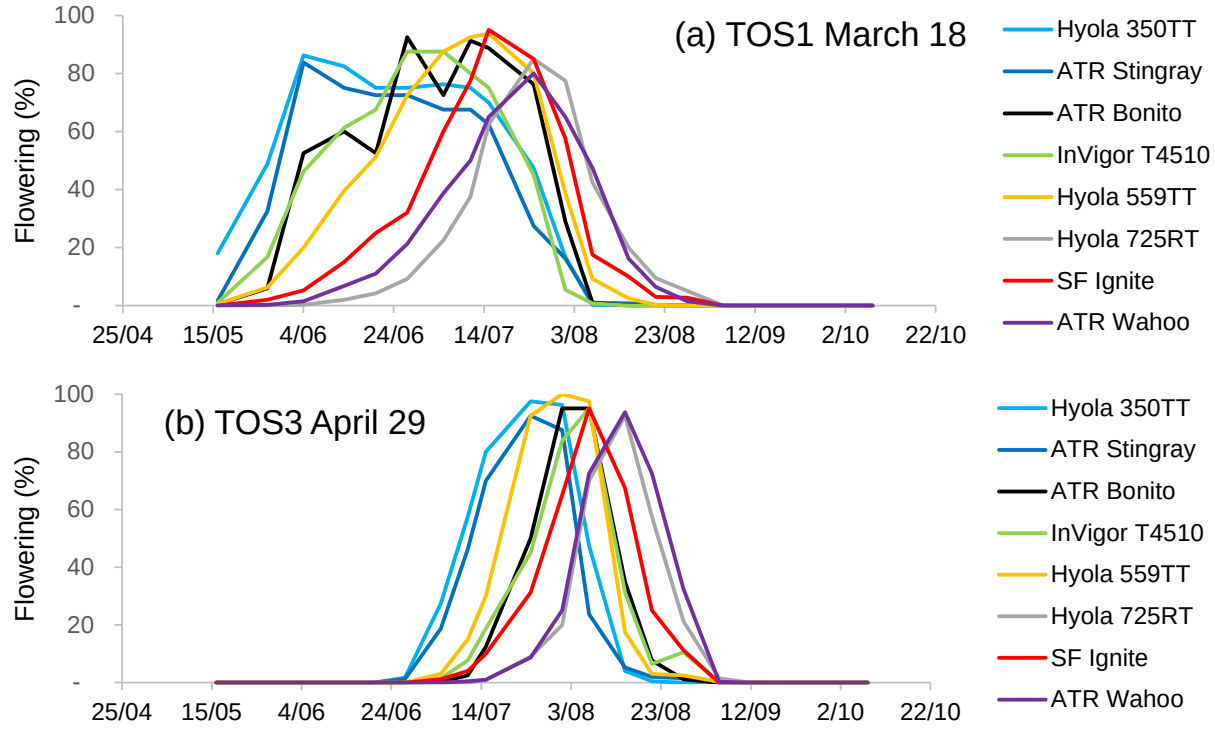

Fig 1 With very early sowing (a), flowering started at an earlier date, extended over a longer period and magnified differences between varieties, compared with 'traditional' (b) sowing at Mullewa in 2019.

The greater difference in flowering time with early sowing is due to the early maturity varieties accumulating their thermal time requirement more quickly, in the warmer conditions, whereas the longer season varieties display behaviour consistent with a vernalisation response and there was a longer period of time until the cool conditions occurred to satisfy this. Preliminary examination of the thermal time and vernalisation conditions supports this.

The phenology has been mapped with seasonal conditions, for example Mullewa in 2019 (Fig 2), illustrating incidences of frost at the end of flowering for March sown plots, but avoidance of heat stress at the end of flowering. With May sowing, there was heat stress close to flowering and lack of rainfall for grain fill (after flowering).

Total plant biomass of very early sown plots ranged from 7 t/ha at Mullewa in 2019, to 13.6 at Wongan Hills in 2020. Biomass was highest and similar (no statistical difference) for the first two sowing times at all sites, apart from Mullewa in 2019 where the later sowing had lower biomass. In the Dale 2020 trial, biomass was statistically similar for all seeding times. Biomass is highly correlated with final yield (Zhang and Flottman 2016), effectively supporting grain fill towards yield potential.

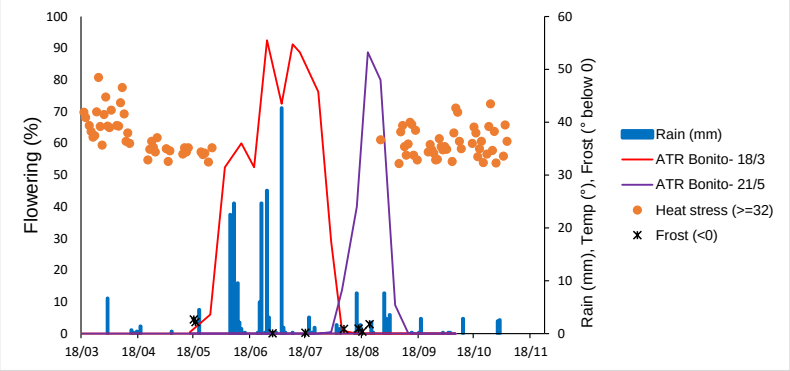

Fig 2 Phenology fit with seasonal conditions for March 18 sowing (red line), or May 21 sowing (purple)

Yield, quality and profit

Trial yields were highest and similar with sowing on March 18 or April 8 for all trials. At Dale, there was no difference between yields with the first three TOS in 2020 and the first four TOS in 2019, reflecting the longer growing season at this site. Average TOS1 yields ranged between 1.4 t/ha at Mullewa in 2019 and 3.4 t/ha at Wongan Hills in 2020 (Table 1). There was an average 0.55t/ha yield benefit from sowing on either March 18 or April 8, compared with April 20. The oil content (%) often declined with later seeding times, hence gross returns followed the same pattern as yield.

Table 1 Average yield (t/ha) was highest and similar with sowing on March 18 or April 8 for all trials**.**

	Mullewa		Wongan Hills		Dale	
TOS	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**
March 18	1.38a	1.58a	2.48a	3.42a	2.21	2.35a
April 8	1.23a	1.39ab	2.38a	3.23a	2.45	2.33a
April 29	0.83b	1.18b	1.43b	2.05b	2.12	2.27a
May 20	0.64b	0.29c	1.25b	1.05c	2.04	1.47b
June 11	0.14c	N/A	1.22b	N/A	1.32	N/A
TOS *P*	0.001	0.001	0.004	<.001	0.059	0.016
Var *P*	0.003	<0.001	<.001	<.001	<.001	<.001
TOS.Var *P*	ns	<0.001	<.001	<.001	<.001	<.001
TOS.Var LSD	0.3898	0.2539	0.5363	0.4358	0.6831	0.406

Risk factors

Follow-up rain is the first risk factor for early sowing. This is evident at the warm northerly site of Mullewa where post-seeding irrigation for crop survival was 70 mm in 2020, applied in 12 small applications, indicating a high demand at this site, compared with only one or two applications needed at other sites.

The field establishment was significantly reduced for the March sowing at all sites. Since the sites had pre-seeding irrigation, this is likely to be due to the high soil temperatures. The field establishment was low for both March (16%) and early April (24%) sowings at Mullewa in 2020, compared with 48-76% for later sowing times. At these early sowing times, the soil surface temperature was 38-40°C on nearby dry soil, and at 26-28°C in the moist seed bed at 1cm deep, and followed by 9 days (TOS1) and 4 days (TOS2) with temperatures between 35-40C.

With very early sowing, there is a higher risk of frost at the end of seeding, which has been mapped for the 2019 Mullewa trial in Fig 2.

Predation and disease are other risk factors of early sowing. Insect predation was an issue with diamond back moth (DBM) infestation at our 2020 Grass Patch site. The wet conditions for very early sowing provide host plants and the warm early conditions support rapid life cycles. Green Peach Aphid may also build up early in the season in a similar way. We also found bird and animal predation to be a major issue, so early sown plots were fenced and netted. Disease is more likely in early sown crops due to higher biomass and the longer flowering period providing an extended opportunity for sclerotinia infection. There were significant sclerotinia infections in the first two times of sowing at Dale in 2020, although it was a relatively dry year. Weed control can also be more difficult, since ryegrass germination is delayed until cooler conditions.

Variety differences

Yields for the longer season varieties were generally highest at the first time of sowing, for both ATR Wahoo and SF Ignite. Hence, long season varieties are best sown early. However, the early mid variety InVigor T4510 significantly out-yielded both longer season varieties at TOS 1 at Mullewa 2020 and Wongan Hills 2019, and yielded similarly to the longer season varieties in 2020 trials at Wongan Hills and Dale, while SF Ignite was highest yielding only at the 2019 Dale trial. In these experiments, choosing an adaptable early-mid maturity variety generally resulted in highest or similar yield to other varieties with early or late sowing. There may be a different outcome in longer season areas, or with new long-maturity varieties.

Conclusion

Sowing in March did not produce higher yields than sowing in April, but provides further sowing opportunities for growers to consider. Once the crop is established, there appeared to be no physiological disadvantages from early sowing and an early start to flowering.

Yields were highest from sowing in March or Early April, averaged over all trials at 0.55t/h higher than the traditional sowing at the end of April.

Risk factors of early sowing include an increased reliance on follow-up rain, low or staggered field emergence (due to higher temperatures at seeding), frost at end of flowering, insects (especially DBM and green peach aphid, which are both likely to build up in situations suited to very early sowing) and animal predation and disease. Growers should evaluate risks in their system, including seasonal outlook, heat conditions at seeding, if in a frost area or frost prone paddock, green bridge or insect host availability, likely presence of nearby canola paddocks, to alleviate predation pressure, and the presence of known predator populations, past disease pressure and rotation for disease risk management. Where growers are considering March sowing, reduce risk by seeding only part of the canola program at this time, increase the sowing rate of OP canola and monitor for pests and disease.

When sowing in March and early April, growers do not need to use a 'long season' variety in WA. In these experiments, the early-mid variety InVigor T 4510 generally produced equal or higher yields compared with the longer maturity varieties, at all times of sowing. However, long maturity varieties should be used when there is a reasonable risk of frost in the region or landscape.

References

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Acknowledgements

Acknowledgement and appreciation to DPIRD and GRDC for financial support (DAW 1901-005RTX). Thanks to Helen Cooper, Salzar Rahman and Stephanie Boyce for excellent technical support, as well as trial management provided by DPIRD Field services units and Living Farm staff (Dale site). Thanks to farmers who hosted trials Glen and Eliza Thomas, Critch family, Bill and Anne Cleland, and Michael Ietto