CANOLA PHENOLOGY

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TAKE HOME MESSAGES

- Selecting mid-fast hybrid varieties with flexible phenology in the Wimmera is a good risk management option, which also has yield potential when seasonal conditions are favourable.
- Fast hybrids have performed well but avoid the temptation to plant these early if an early break eventuates.
- Selecting slow developing varieties comes with added risk of requiring a germinating rain in the first week of April or earlier.
- The best return on investment in nitrogen comes with application to hybrids that flower at the optimum time for the environment.

BACKGROUND

Understanding the phenological responses of a canola variety will guide sowing decisions to ensure flowering starts in the optimal window to maximise yield potential. This means flowering is timed to avoid the stresses of frost and disease (too early); and drought and heat (too late), while allowing the time and favourable conditions required for canola to grow and produce a high yield potential.

Through the GRDC-funded Optimised Canola Profitability project (CSP00187), research has been carried out in the Wimmera region from 2015 to 2018. Findings of this research, focusing on time of sowing (TOS), have shown phenological differences are amplified when canola is sown before mid-April, meaning a few days difference in start of flowering between a fast and slow variety when sown in early May, but a matter of weeks for the same varieties sown in early April. Thus, varieties should be chosen carefully, based on phenology and herbicide options, in the event of early sowing.

In 2017 and 2018, BCG included nitrogen (N) application rates to assess the response of varieties sown at different times. This research found that open pollinated triazine tolerant varieties didn't respond to the application of N as well as hybrid varieties (Brill and Taylor 2017).

AIM

To determine the optimum management of canola plant type and phenology when sown earlier than traditional sowing time (25 April). To assess the response of canola varieties to high and low application rates of N on grain yield and grain quality.

PADDOCK DETAILS

Location:	Longerenong
Crop year rainfall (Nov-Oct):	284mm
GSR (Apr-Oct):	187mm
Soil type:	Clay
Starting soil moisture:	49mm
Available N at sowing:	68kg/ha
Paddock history:	2016 lentils, 2017 barley

TRIAL DETAILS

Crop type:	Canola
Treatments:	Refer to Table 1
Target plant density:	50 plants/m^2
Seeding equipment:	Knife points, press wheels, 30cm row spacing
Sowing date:	TOS1 – 13 April 2018, TOS2 – 8 May 2018
Replicates:	Four

TRIAL INPUTS

Fertiliser:	Granulock® Supreme Z + Impact® @ 90kg/ha at sowing For in crop treatments refer to Table 1

Herbicide, insecticide and fungicide managed to best practice.

METHOD

A replicated split plot design trial was sown at two TOS. This trial was established with drip irrigation in crop rows of 15mm on TOS1 and 7.5mm on TOS2 due to a rainfall event prior to TOS2. Assessments carried out on the trial included establishment counts, NDVI, flowering dates, biomass at 50 per cent (%) flower, yield (from harvest cuts taken at varietal maturity), harvest index and grain quality. Table 1 indicates N treatments were top-dressed as urea at either a low rate (targeting 1.4t/ha yield) or high rate (targeting 5t/ha yield).

Table 1. Treatment outline.

Variety	Phenology	Time of sowing (TOS)	Nitrogen application
Diamond	Fast	TOS1 (13 April)	5 June – low rate @ 41.5kg urea/ha (Targeting 1.4t/ha yield)
ATR Stingray	Fast	TOS2 (8 May)	High rate @ 667.5kg urea/ha split application 5 June and 2 July (targeting 5t/ha yield)
44Y90 CL	Fast – mid		
ATR Bonito	Fast – mid		
45Y91 CL	Mid – slow		
45Y25 RR	Mid – slow		
ATR Wahoo	Mid – slow		
Archer	Slow		

RESULTS AND INTERPRETATION

Biomass

There was a general trend for greater biomass at flowering from all varieties sown on May 8 (TOS2) except for Archer as there was a TOS by variety interaction (P=0.014). 45Y91 CL and 45Y25 RR with their similar phenology produced, on average, the same biomass in the respective sowing times. Diamond and ATR Stingray also with similar phenology to each other had a large difference in biomass at flowering which is due to the hybrid vigour of Diamond. This trend was observed for 44Y90 CL versus Bonito and Archer versus Wahoo when comparing varieties with similar phenology. On average the May 8 sowing time produced 0.7t/ha more biomass than the April sowing.

There was also an interaction observed between varieties and N application rates where all varieties showed, on average, greater biomass at flowering under the high N application. On average the high N treatments averaged 1.2t/ha more biomass at the 50% flowering cut timing. The later developing hybrid varieties of 45Y91 CL, 45Y25RR and Archer had the largest response to N and significantly produced more biomass at this timing than the other varieties in the trial (Figure 1).

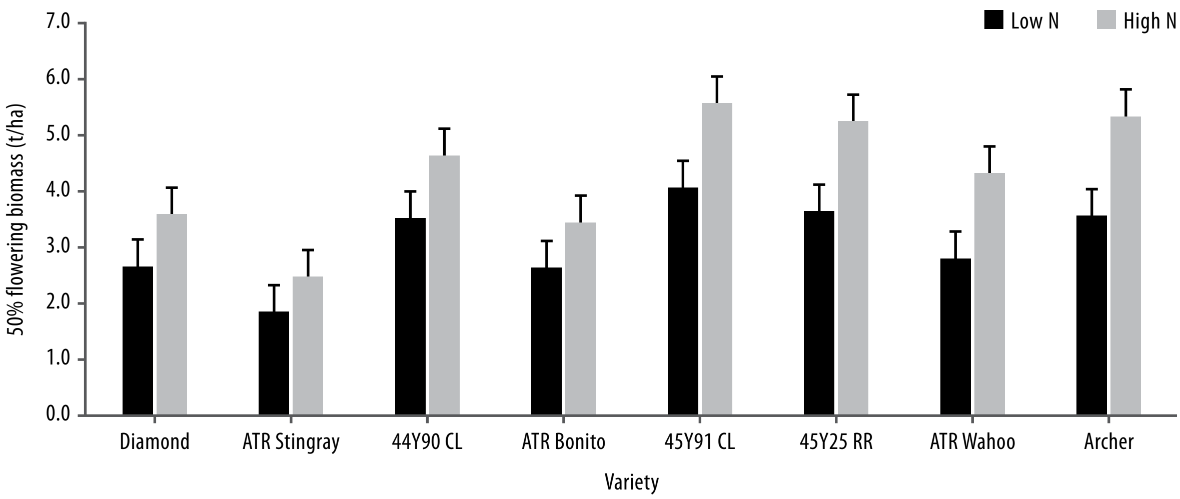

Figure 1. Mean of 50% flowering biomass (t/ha) for varieties at different N application rates. Stats: P=0.009, LSD=0.50t/ha, CV=13.5%.

Yield

Yield was variable across treatments with an interaction found between varieties, TOS and N rate. 44Y90 CL at the early sowing topped the trial yields with 1.46t/ha which was closely followed by 45Y91 CL and Diamond yielding 1.24 and 1.21t/ha respectively all sown in the early April timing. As a fast hybrid variety, Diamond showed the most consistent yield across TOS and N rates (Table 2). Diamond has performed consistently well through the last three years in the trials.

Table 2. Grain yield (t/ha) of varieties at different TOS (13 April, 8 May) and under different N application rates (high N and low N) in 2018.

Variety	TOS1 (13 April)		TOS2 (8 May)	
	Low N	High N	Low N	High N
Diamond	1.04	1.21	0.96	1.15
ATR Stingray	0.64	0.97	0.85	0.42
44Y90 CL	0.89	1.46	0.91	1.19
ATR Bonito	0.51	0.51	0.86	0.47
45Y91 CL	0.76	1.24	0.83	0.35
45Y25 RR	0.83	0.62	0.64	0.31
ATR Wahoo	0.61	0.27	0.59	0.16
Archer	0.92	0.68	0.69	0.55
Sig. diff.	P<0.001			
LSD (P=0.05)	0.26			
CV%	24.4			

Research from 2017 found OP TT varieties did not respond as well to N as hybrids (Brill and Taylor 2017). ATR Bonito and ATR Wahoo had a negative response to high rate N application in 2018 but ATR Stingray had a yield increase with high rate of N application in the early TOS and a negative effect in the later TOS. In general, TT varieties showed less of a response to N application than fast developing and early sown mid developing varieties in 2018. 45Y25RR, Wahoo and Archer, displayed a negative yield response to N application, similar to TT varieties.

As the application of a high rate of N reduced the yields of some varieties, the effect was more evident with slower developing and open pollinated TT varieties at the later sowing timing. This is likely due to the very high N levels causing canola to hay off in the 2018 seasonal conditions.

This theory is substantiated by biomass at maturity where biomass did not always reflect final yield unlike other seasons (Figure 2). ATR Wahoo, a later maturing variety had greater biomass at maturity from high N application treatments however, low N application treatments out yielded at each TOS suggesting it may have hayed off early limiting the ability to fill grain.

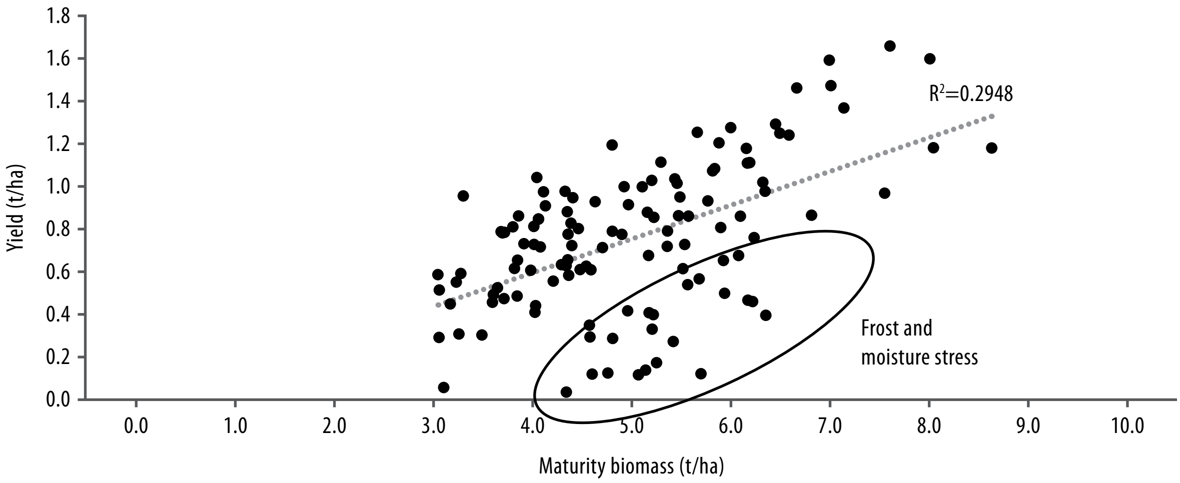

Figure 2. Maturity biomass (t/ha) and grain yield in 2018. Circled area represents the data points either effected via frost and/or moisture stress causing a 'haying off' effect.

Grain quality

Oil content was below 42 per cent for all treatments with high N application reducing oil. Lowest oil content was found in high rate N treatments for Diamond and ATR Wahoo (Table 3). This is an expected trend as high N is known to have a negative impact on oil content (O'Brian and Street, 2017). All test weights were within the acceptable range for canola. ATR Stingray consistently averaged the highest test weight between TOS and N application rates.

Table 3. Mean oil (%) of varieties at different sowing times and under different N application rates.

Variety	TOS1		TOS2	
	Low rate	**High rate**	**Low rate**	**High rate**
Diamond	40.9	34.4	38.9	33.1
ATR Stingray	37.2	36.5	39.9	35.8
ATR Bonito	40.7	37.7	41.2	39.0
44Y90 CL	41.0	36.3	38.9	36.8
45Y91 CL	40.2	36.6	39.7	38.5
45Y25 RR	38.9	36.2	40.7	37.2
Archer	38.3	35.9	38.6	36.8
ATR Wahoo	40.1	34.5	38.6	33.5
Sig. diff.	P=0.016			
LSD (P=0.05)	1.8			
CV%	3.2			

Flowering windows

Diamond, an early maturing variety, was the first to begin flowering in both TOS with both flowering within the optimal start of flowering (OSF) window for Horsham (18 July-25 August). There was a trend seen towards a decrease in yield when flowering was not reached by the end of the OSF on 25 August. Sowing on 8 May (TOS2) was too late for most treatments to begin flowering within the OSF window, driven by maturity.

Earlier sown varieties flowered earlier and averaged a higher grain yield. When the OSF date had passed there was a general decrease in yield observed for all herbicide tolerance groups. It is important to note frost data has not been taken into account to quantify the contribution to yield losses.

COMMERCIAL PRACTICE

Overall canola production

Growing canola in the Wimmera during the last four seasons has been highly variable and has come with considerable risk. Wimmera canola phenology trials have averaged 2t/ha (Table 4). The learnings from the trials have indicated with the good variety choice, N management and taking early sowing opportunities to match the varieties optimal phenology windows, the risk of the season's variations can be managed, with a maximum upside of 2.77t/ha average over the four years.

Table 4. Combination of data from four years of canola phenology data in the Wimmera.

Year	**2015**	**2016**	**2017**	**2018**
Previous crop type	**Wheat**	**Faba bean**	**Lentil**	**Barley**
Nov – Oct rainfall (mm)	228	467	424	284
Apr – Oct rainfall (mm)	125	374	303	187
Biomass 50% flower initiation (t/ha)	1.62	4.13	4.83	3.7
Biomass maturity (including grain) (t/ha)	2.08	11.85	11.70	5.01
Yield (t/ha)	0.12	3.46	3.83	0.75
Harvest index	0.06	0.29	0.32	0.15

Alternative end uses in a dry frosty season

A lot of commercial canola crops were cut for hay in the Wimmera in 2018 due to frost events during flowering and early pod development. Initial assessments indicated as high as 50 per cent damage. This combined with the very dry climate forecast was the driver to cut canola hay. BCG's previous trial work in 2007 described the relationship between cutting canola hay early and maximising on good quality (McCormick 2007). A lot of farmers capitalised on this and produced quality canola hay that sold for a premium price. Commercial canola hay yield reports were variable and anywhere between 1-5t/ha and sold for up to $300/t.

In this research trial, harvest index numbers were half of that in a good production year with an average of 0.15 and a range of 0.24 to 0.04t/ha which made the decision to cut hay relatively hard. In general, the later developing varieties with large amounts of N applied produced the greatest amount of biomass and the least amount of grain indicating that these could have been turned into hay.

Variety selection based on yield

The last two years of trial work has suggested sowing fast to mid-fast hybrid varieties are proven consistent high performers. Hybrid varieties have been out-performing open pollinated varieties consistently through the years when comparing amongst phenology groups (Table 5). When considering a long season canola in the Wimmera, a germination early (first week of April) in the season is required to ensure the greatest chance of profitability. Considering the increased cost of holding a long season canola variety and relying on a germinating rain in early April, it may not be an opportunity to access seed and sow in a timely fashion. Selection of a variety like 44Y90 CL with flexible phenology (slows from early sowing but speeds up with late sowing) will help capitalise on early breaks while also yielding well in later starts.

Table 5. Yield by TOS from 2017-18 trials presented as a percentage of the mean.

Breeding method	Phenology	Variety	2017 (3.82)		2018 (0.75)		Average (2.29)	
			TOS1	TOS2	TOS1	TOS2	TOS1	TOS2
Hybrid	Fast	Diamond	108	106	150	141	129	123
Open pollinated	Fast	ATR Stingray	92	95	107	84	99	89
Hybrid	Mid-fast	44Y90 CL	104	107	161	140	132	123
Open pollinated	Mid-fast	ATR Bonito	90	91	68	88	79	90
Hybrid	Mid-slow	45Y25 RR	108	106	92	59	100	83
Open pollinated	Mid-slow	ATR Wahoo	99	91	59	49	79	70
Hybrid	Slow	Archer	101	97	105	82	103	90

Nitrogen application

When applying N to canola, the rule of thumb has been to supply 80kg N/ha (between soil, fertiliser and mineralisation) for one tonne of grain yield potential. The previous two seasons we have seen positive responses to biomass when applying high levels of N which generally translate into higher yields (Figure 3). In 2017 it was observed that hybrid varieties were better able to capture the higher yield potential when larger rates were applied. In 2018, higher biomass was achieved in all varieties when N was applied but the high N treatments had a "haying off" effect on yield in the slower hybrids and the later sown open pollinated varieties. The fast and mid-fast phenology varieties increased or maintained their yield with higher rates of N applied. The results suggest that there is less risk in applying higher rates of N to fast and mid-fast varieties sown in the correct windows with large upside in a good season and risks mitigated in a poor season.

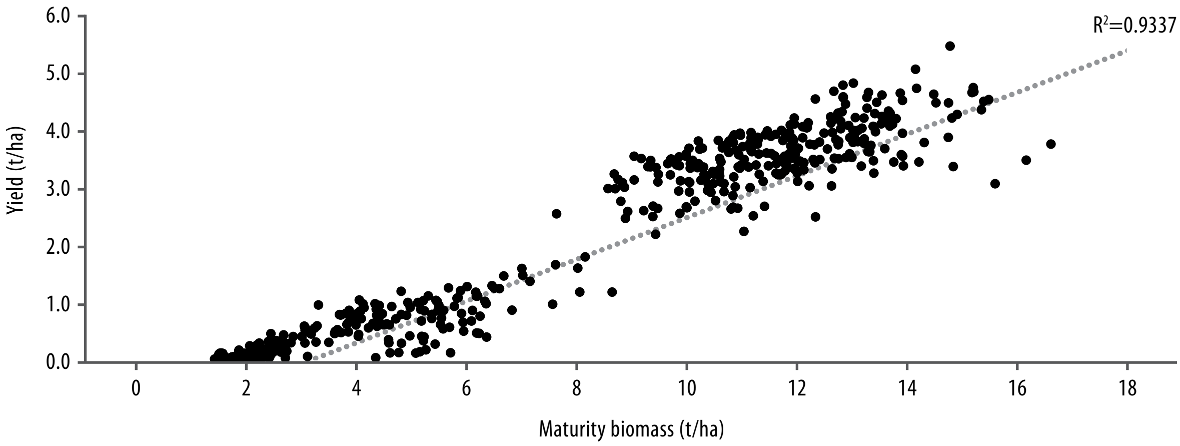

Figure 3. Maturity biomass (t/ha) and grain yield (t/ha) for all trials 2015 to 2018.

ON-FARM PROFITABILITY

In 2018 canola profitability was heavily dependent on stored soil moisture and variety selection. The decision of taking canola through to grain or cut for hay was paddock dependent on suspected frost damage and biomass present at time of cutting. Grain prices at harvest were $560/t and good quality hay was $300/t. The variable costs of producing hay are estimated at $90/t for cutting, raking, baling and stacking vs grain $70/ha for windrowing and harvesting costs.

The thresholds for hay vs grain were, for every 1t of grain, more than 2.33t of hay needed to be produced for the hay option to be more profitable. This option is not always preferred as the labour requirement is significantly increased when producing hay. Canola hay is difficult to cure effectively as the required cutting timing is generally very early in the season with heavy dews and cooler days compared to cereal hay. Once the canola hay is cut there is limited opportunity to rake and manipulate the hay due to the losses of leaf material when dry.

The project has shown with correct management, canola can be a very profitable crop that provides a break from weeds and disease. Selecting a paddock with high nutrition and stored soil moisture will mitigate against fluctuations in yield in response to a variable climate.

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