Canola agronomy and phenology to optimise yield

Andrew Ware[1], Blake Gontar[1], Jacob Giles[1], Christine Walela[1], Ian Ludwig[1], Julianne Lilley[2], John Kirkegaard[2], Rohan Brill[3], Therese McBeath[2], Jeremy Whish[1], Michael Moodie[4]

[1]SARDI, New Variety Agronomy, [2]CSIRO, Food and Agriculture, [3]NSW DPI, Wagga Wagga, [4]Moodie Ag, Mildura

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Key findings

- Improved knowledge of how canola varieties develop in differing regions and the drivers behind development will assist growers in choosing the correct variety for a particular sowing opportunity.
- The development of site specific optimal flowering windows, where the balance between plant growth and frost and heat risks are accounted for, will allow growers and advisors to match canola variety selection with sowing opportunities.
- Nitrogen is an important driver of canola yields in above average seasons. Low risk techniques to ensure adequate nitrogen supply are critical to capitalise on above average rainfall in the low rainfall zone.

Background

Research to better understand yield drivers of canola in eastern Australia commenced in 2014 to 2016 focusing on improving the profitability of canola as part of the “Optimised Canola Profitability (OCP)” project. The research is targeted at low to medium rainfall zones of Eastern and Southern Australian cropping regions and is a collaboration between CSIRO, NSW DPI and GRDC, in partnership with SARDI, CSU, MSF and BCG. The project links closely with similar GRDC supported projects in Western Australia and high rainfall zones (HRZ).

2016 Season

The 2016 season in South Australia was typified by average to above average rainfall in most of the cropping region between April and August. Significantly higher than average rainfall fell in September and October. Average daily temperatures (daily maximum minus daily minimum divided by two) tended to be average to slightly warmer than normal between April and August and then considerably below average in September and October. Solar radiation was lower than normal (about 8% below average figures) placing 2016 as having one of the lowest cumulative totals of solar radiation for the growing season on record.

All of these factors had an effect on canola yields observed in 2016, challenging some of the results gathered by this project in previous years.

2016 Results

Similar to 2014 and 2015, in 2016 three time of sowing (ToS) x variety experiments were conducted at Yeelanna (Lower EP), Hart (Mid-North) and Lameroo (Murray Mallee). The grain yields show that the 2nd and 3rd sowing times at Yeelanna and Hart and the 1st and 2nd at Lameroo resulted in the highest yields in 2016. In general, these results are a reflection of the cooler and wetter finish to the 2016 season.

Table 1. Grain yields (t/ha) from time of sowing x variety experiments conducted at Yeelanna, Hart and Lameroo in 2016.

Variety	Yeelanna			Hart			Lameroo		
	8 April	20 April	6 May	15 April	2 May	16 May	13 April	28 April	12 April
44Y89CL	3.11	3.76	2.99	2.16*	2.67	2.83	2.11	2.41	1.83
45Y88CL	3.86	3.22	3.77	2.36*	2.81	3.08	2.01	2.19	1.53
Archer	3.72	3.87	3.43	2.80	3.17	3.05	2.14	1.86	1.27
ATR_Gem	2.72	2.78	3.40	1.69*	2.47	2.31	2.04	1.74	1.24
ATR_Stingray	2.11	2.89	2.42	2.00*	2.77	2.92	1.24	1.82	1.38
Hyola559TT	3.45	3.49	3.78	2.47*	3.03	3.05	2.18	2.31	1.61
Hyola575CL	2.91	4.04	4.45	1.98*	2.58	2.61	1.71	1.87	1.67
Hyola750TT	3.53	3.42	3.20	2.23*	2.81	2.39	2.09	1.65	1.17
Nuseed_Diamond	3.35	4.19	4.36	1.94*	2.08	3.26	1.80	2.74	1.76
Average	3.20	3.52	3.53	2.18*	2.71	2.83	1.92	2.06	1.50
lsd 5% (TOS)	0.16			0.18			0.17		
lsd 5% (variety x TOS)	0.47			0.53			0.52		
p (variety x TOS)	<.001			<.001			0.03		
GS Rainfall (Jan-Mar)	449 mm (71mm)			330mm (62mm)			300mm (47mm)		

* Yield adjusted to account for bird damage

The 2016 experiments showed that the short season variety Nuseed Diamond sown at ToS3 gave the highest grain yields at Yeelanna and Hart. The longer season variety, Archer yielded well in ToS1, but failed to match the yields of Nuseed Diamond sown late.

It should be noted that early flowering varieties sown early suffered from higher levels of upper canopy blackleg and sclerotinia infection compared to later sowings.

Given that experiments in previous years have demonstrated considerable benefits from sowing early, results from 2016 raise the question of how yields can be maximised in every season. The 2016 season was a usual year from a historical sense of the grain growing regions of South Australia. This season demonstrated how important it is to capitalise on the opportunities of late season rainfall.

How do canola varieties develop and why is it important?

The most common and easily recognised stages of canola development are emergence, green bud, flowering, podding and maturity. The development of canola crops is largely driven by temperature (thermal time), but is also affected by vernalisation and photoperiod to differing degrees in different varieties.

Thermal Time

Day degrees are the units of a plants biological clock. They are a way of combining time and temperature into a single number. To calculate the thermal time target for a plant's development stage you accumulate the day degrees until a specific target is reached, e.g. variety X accumulates 1000 degree days between emergence and flowering.

Vernalisation

Vernalisation can be described as a low temperature promotion of flowering. For canola if the average temperature is two degrees or below, then one vernal day is accumulated, no vernal days are accumulated if the average temperature is below zero or greater than 15. Between two degrees and 15 degrees only a proportion of a vernal day is accumulated.

There are two types of vernalisation; obligate and facultative.

Obligate vernalisation is the need for a plant to accumulate cold days before the day degree calculation can begin. This typically drives the development of Winter type canola varieties.

Facultative vernalisation occurs in both Spring and Winter type canola. It simply means the more cold days the plant accumulates between sowing and floral initiation (stage before green bud) the lower the thermal time target required.

Photoperiod (Day length)

Photoperiodism, is the response of plants to increasing or shortening day lengths. Long day plants (canola) respond to increasing day length. As you move from Winter to Summer the days lengthen and the crop requires fewer day degrees to move between growth stages so flowers earlier.

Once the drivers of phenological development for a particular variety are understood they can be used in models, such as APSIM, to determine how they will grow and develop in a particular environment. But to maximise yield, as discussed previously, an optimal flowering window for that environment needs to be developed and then an optimal sowing date for the variety extrapolated.

Optimal flowering period (OFP) for canola in South Australia

Crops which flower too early may have insufficient biomass or frost damage, while late flowering increases heat and water stress. Despite its importance, OFPs for canola have not been comprehensively defined for canola across eastern Australia's cropping zone, especially for crops sown prior to the traditional sowing window (late April to early May). Identifying the OFP is a first step to establish appropriate variety by sowing date combinations to optimise yields in different environments.

As seen in Figure 1, APSIM modelling can be used to develop an OFP for an example environment, where flowering ideally occurs when frost and heat stress risk are minimised. Once this is known the ideal sowing date can be generated for a variety based on historical meteorological data and knowledge of the drivers of the variety's phenological development.

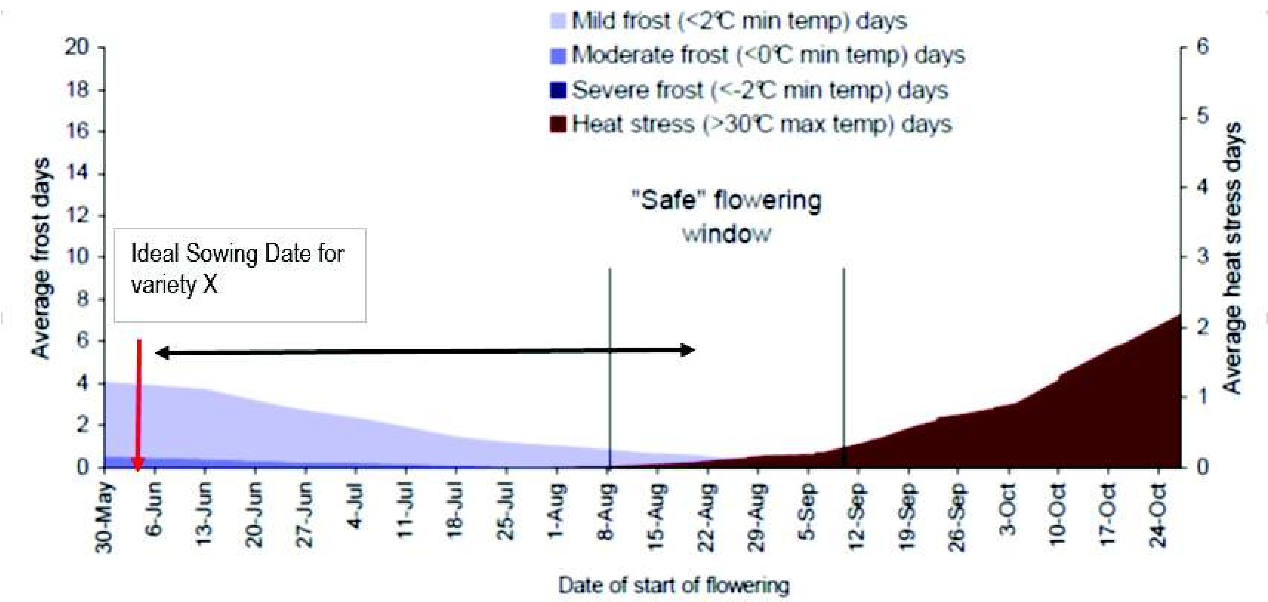

Figure 1. Example of how an optimal flowering period is generated and then an ideal sowing date is developed for an example environment.

Once an optimal sowing date for a particular variety is known then historical meteorological data can be used to determine how likely a sowing opportunity within the optimal window occurs for that location (Figure 2).

The development of OFP for South Australia is now well advanced and an increased understanding on the phenological drivers of recently released canola varieties is also being updated into crop models such as APSIM, meaning that growers and advisers will shortly have access to techniques that offer the potential improve canola productivity in their region.

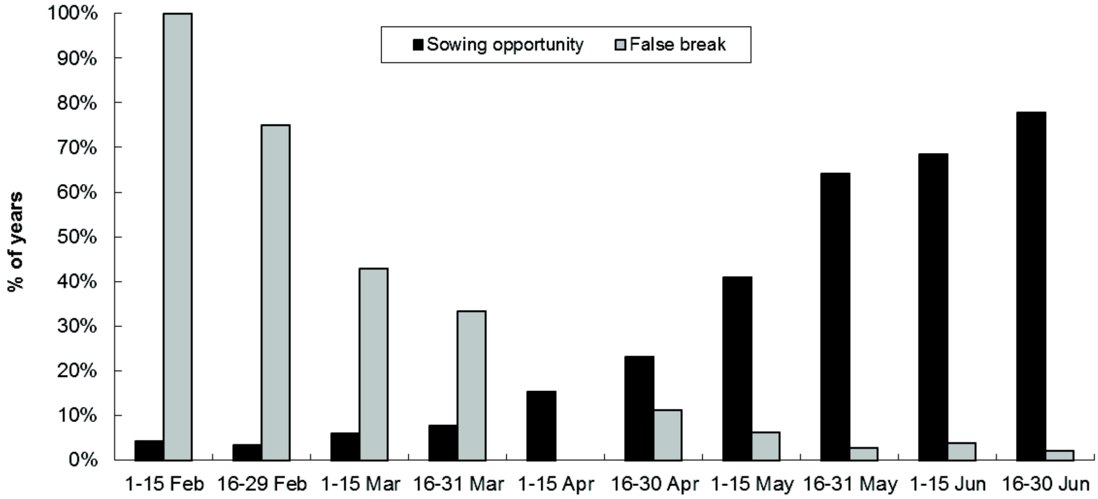

Figure 2. Hart sowing opportunities: for fortnightly periods the frequency of years with a sowing opportunity (i.e. rainfall > pan evaporation over 7 days) and the likelihood of a false break with no further effective rain (i.e. rainfall < pan evaporation over 7 days) in the subsequent 6 weeks.

Conclusion

The grain yields achieved in field experiments conducted at Yeelanna, Hart and Lameroo in 2016 showed that having the correct variety x ToS combination enabled yields to be maximised. An increased understanding of how a canola variety develops can be used in combination with the development of OFPs for a particular location so that optimal sowing times can be generated. Managing canola risk in low rainfall areas remains challenging if yields are to be maximised in above average rainfall seasons.

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Contact details

Andrew Ware
PO Box 1783 Port Lincoln, SA 5606
0427 884 272
andrew.ware@sa.gov.au