SECTION 3

Planting

3.1 Seed treatments

3.1.1 Insecticide treatments

Imidacloprid products, such as Gaucho® 600 or Picus, are registered for use on canola seed, for protection against redlegged earth mite, blue oat mite and aphids.

These chemicals work through repellency and anti-feeding action, rather than by directly killing earth mites or aphids. They will protect emerging seedlings for 3–4 weeks after sowing. As well as the direct effects of controlling aphids, the use of imidacloprid may also reduce the incidence and spread of aphid-transmitted virus diseases during this period. This product can be applied only by registered operators. All seed companies can supply seed pre-treated with imidacloprid. Fipronil (e.g. Cosmos®) is registered for control of redlegged earth mite in canola. It should be used as part of an integrated pest management approach to redlegged earth mite.

Fipronil can be applied either on-farm or off-farm by a contractor or seed company. [1]

More information

[Oilseeds WA: Assessment of fungicide efficacy against blackleg disease]

[Research paper: Evaluation of fungicides for the control of downy mildew]

[Bayer CropScience: Prosaro®—the most effective foliar fungicide treatment against blackleg and sclerotinia]

3.1.2 Fungicide treatments

Fluquinconazole products (e.g. Jockey®) can be used in high-risk situations as a seed dressing to help minimise the effects of blackleg disease. These products may shorten the hypocotyl length of canola. To avoid the possibility of reduced emergence, do not sow treated seed deeper than 20 mm or in soils prone to crusting. Ensure that treated seed is sown in the season of treatment.

Fludioxonil + metalaxyl-M (Maxim® XL) is a fungicidal seed dressing that provides suppression of blackleg as well as protection against seedling diseases caused by *Pythium* spp. and *Rhizoctonia solani*. It will not cause shortening of the hypocotyl or affect seed viability.

Flutriafol products (Impact®) are in-furrow fungicide treatments that are mixed and sown with the fertiliser to assist in minimising the effects of blackleg disease. In situations of high blackleg pressure, research has shown flutriafol products to be superior to other fungicides for controlling blackleg disease. [2]

3.2 Seed placement

Sow canola seed into the soil, rather than dropping it on the soil surface and harrowing it in. Drilled seed is more accurately placed in contact with moisture and will germinate more uniformly.

Deep furrow planting, which allows sowing into subsurface moisture through the dry surface soil, is a proven technique in these soils, where rainfall is summer dominant and surface seedbeds are often dry at sowing time. When deep furrow planting, it is critical

[1] L Jenkins (2009) Crop establishment. Ch. 5. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

[2] L Jenkins (2009) Crop establishment. Ch. 5. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

that moist soil is firmed around the seed but only 2–3 cm of moist soil is covering the seed.

On lighter, sandier soils moisture seeking points in conjunction with 'V' shaped press wheels give excellent results. When sowing into wet soils, take care to avoid a smearing action by the moisture seeking points, which could reduce crop emergence.

Broadcasting seed through the seeder's small seeds box is unreliable and usually results in staggered germination. Thoroughly clean the seeder out after sowing to prevent seed residue from contaminating other crops sown later in the season. [3]

3.3 Time of sowing

Sowing time is a compromise between sowing too early, which may increase the risk of frost damage and lodging, and sowing too late, which increases the risk of the crop undergoing seed development in increasingly hot and dry conditions, reducing the yield potential and oil content of the grain.

For each week that sowing is delayed, yields drop by ~5% in South Australia and Victoria. The yield penalty can be even higher in seasons with a dry finish.

In general, sowing at the earliest time within the optimum window pays off in a number of ways. Earlier sown crops have the following advantages:

- They generally have higher seed and oil yields with the crop finishing under cooler, moister, conditions. A premium is paid for oil content >42%.
- They allow for better coordination of sowing and harvesting, because these operations for canola are well ahead of main wheat season.
- They grow faster initially and so compete better with weeds.
- Earlier sown crops normally have fewer problems with insect pests, such as aphids, in spring.

Because canola seed is very small, it takes longer to establish than cereals. Late sowing into cold soils further reduces plant growth, making canola seedlings more vulnerable to disease, insects, slugs and other constraints.

Late sowing also results in canola maturing when the weather is typically warmer and drier. Hot weather during the flowering–pod-set stages may cause pod abortion, fewer seeds per pod, and reduced oil content.

Canola usually flowers for 3–5 weeks, and frost damage is greatest if frost occurs towards the end of flowering and through podfill. Early-maturing varieties sown at the beginning of May would be subject to frosts in the late-flowering and pod-filling stages, whereas midseason varieties will flower and fill pods later, reducing the risk of frost damage.

Ideally, the small seeds of canola need to be sown no more than 5 cm deep in self-mulching clays (2–3 cm in red soils) into well-prepared, moist seedbeds.

Good seed–soil contact, to help ensure uniform establishment, is aided by the use of rollers, cultipackers and press-wheels. The crop is suited to conventional and no-till systems.

Heavy stubble loads may reduce emergence, and should not be left over the sowing row. Triazine-tolerant (TT) varieties are less vigorous; therefore, planting methods are more critical for even establishment. [4]

3 L Jenkins (2009) Crop establishment. Ch. 5. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

4 L Serafin, J Holland, R Bambach, D McCaffery (2005) Canola: northern NSW planting guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0016/148300/canola-northern-NSW-planting-guide.pdf

More information

BCG: Timing is everything: of barley and canola timing of sowing

Hart Field Trials: Canola growth and development—impact of ToS and seasonal conditions

More information

GRDC: Growing hybrid canola

Hart Field Trials: Retaining hybrid canola seed

GRDC: Canola establishment; does size matter?

NSW DPI: Canola time of sowing, Cowra

AOF: Canola response to time of sowing in the Victorian Mallee

GRDC: Turning sowing times on their head with winter habit canola and wheat

GRDC: Canola growth and development—impact of time of sowing (TOS) and seasonal conditions

The Birchip Cropping Group conducted trials in 2012 showing that early-sown canola gave the highest yields and gross returns. The early-sown crops were able to withstand frosts and avoid the worst of the dry spring. [5]

Trials conducted by the Hart Field Site Group in 2014 and funded by Grains Research and Development Corporation (GRDC) found that early-sowing opportunities may maximise canola yield, but selection of the correct variety is important.

Understanding the drivers behind canola development will help to improve canola management and variety selection. Researchers noted that varietal maturity ratings do not always correlate with varietal phenology. They found that the way each canola variety develops could have a large influence on the resulting yield, when planted at different times and in different environments. [6]

3.3.1 Retained seed

Some growers are interested in retaining hybrids from one season to the next, as they have traditionally done with open-pollinated (OP) varieties. Retaining hybrids to the second generation (F2) will produce seed of inconsistent quality. Depending on how different the parent lines were in certain traits, the F2 generation may vary greatly from the original hybrid. Such variations may occur in herbicide tolerance, blackleg resistance and maturity (see GRDC Fact Sheet: Growing hybrid canola). Those differences may greatly affect the overall yield and financial returns to growers to the point that the initial savings from retaining the seed are outweighed.

3.3.2 Canola growth and development—impact of time of sowing (TOS) and seasonal conditions

This project has three take-home messages:

- Understanding the drivers behind canola development will help to improve canola management and variety selection.
- Varietal maturity ratings do not always correlate with varietal phenology.
- Early sowing opportunities may provide a great opportunity to maximise canola yield, but selection of the correct variety is important.

CSIRO first conducted some pre-trial modelling using the best available information on variety development prior to 2014, and the APSIM model. This explored the potential for planting canola early at a number of locations across Australia and the potential yields that could be achieved by planting cultivars with differing maturity, at a number of sowing times.

Table 1 summarises this work and shows the potential for longer season varieties to be planted in locations such as Cummins and have an improved yield potential; however, the opportunity for successfully sowing these varieties occurs in only 15% of years (where sufficient summer rainfall occurs). [7]

5 BCG (2012) Timing is everything: barley and canola time of sowing. Birchip Cropping Group, http://www.bcg.org.au/view_trial.php?trial_id=863&src=trial_docs.php

6 A Ware, S Noack, S Sheriff (2104) Canola growth and development—impact of ToS and seasonal conditions. Hart Field Site, http://www.hartfieldsite.org.au/media/2014%20Trial%20Results/2014_Results_Canola_growth_and_development_impact_of_ToS_and_seasonal_conditions.pdf

7 A Ware, R Brill, J Kirkegaard, S Noack, A Pearce, L Davis (2015) Canola growth and development—impact of time of sowing (TOS) and seasonal conditions. GRDC Update Papers, 10 February 2015, http://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2015/02/Canola-growth-and-development-impact-of-time-of-sowing-TOS-and-seasonal-conditions

Table 1: Example of possible output from APSIM modelling: showing summary of potential yield for four cultivar phenotypes in four locations (Source: J. Lilley, CSIRO)

Shaded area shows safest sowing window (balance between frost- and heat-stress risk); percentage value is the sowing opportunity (% of years where rainfall allows sowing in this window)

Location	Cultivar phenology type	Sowing-window intervals									Mean potential yield (t/ha)
		8 March	22 March	5 April	19 April	3 May	17 May	31 May	14 June	28 June	
Cummins, SA	CB™ Taurus	10%									4.1
	CBI406		15%								4.0
	46Y78					70%					3.9
	Hyola® 50					70%					3.7
Naracoorte, SA	CB™ Taurus	15%									3.6
	CBI406			42%							3.5
	46Y78					85%					3.4
	Hyola® 50					77%					3.4

This process highlighted a number of gaps in the understanding of many of the canola varieties currently being grown, and led to the 2014 trial program.

Methodology

As part of the GRDC Optimising Canola Profitability project, three preliminary trials were established in South Australia in 2014: at Yeelanna (Lower Eyre Peninsula), Hart (Mid North) and Lameroo (Mallee). Each trial featured the same six varieties (selected for a range of maturity times); three of the varieties were planted at two establishment rates (15 and 45 plants/m²). Each variety treatment was sown at four sowing times, ranging from when the earliest seed was available (mid-April) through to mid-June. Development stages were recorded throughout the season, and grain yield was determined.

A further two trials, part of a canola establishment project funded by *South Australian Grain Industry Trust* (SAGIT), are also reported. These trials were at Minnipa (Upper Eyre Peninsula) and Wanilla (Lower Eyre Peninsula) and had four sowing times but a limited number of cultivars.

Description of varieties used in 2014 time of sowing trials

ATR Gem⦇: early–mid-maturity TT variety. High oil content. Medium plant height. Blackleg resistance rating of MR (resistance group A). Tested in National Variety Trials (NVT) trials 2011–14. Bred and marketed by Nuseed Pty Ltd.

ATR Stingray⦇: early-maturing triazine-tolerant variety. Short height. Moderate–high oil content. Blackleg resistance rating MR (resistance group C). Tested in NVT trials 2010–14. Bred by Nuseed Pty Ltd and DPI Victoria. Marketed by Nuseed Pty Ltd.

Pioneer® 44Y87 (CL): early–mid-maturing Clearfield® hybrid. Moderate–high oil content. Medium plant height. Suited to medium-rainfall areas. Blackleg resistance rating MR (resistance group A). Tested in NVT trials 2012–14.

Pioneer® 45Y88 (CL): mid-maturing Clearfield® hybrid. Moderate–high oil content. Medium plant height. Suited to medium–high-rainfall areas. Blackleg resistance rating R–MR (resistance group A). Bred and marketed by DuPont Pioneer. Tested in NVT trials 2012–14.

Hyola® 559TT: mid–early-maturing TT hybrid. High oil content. Medium plant height. Ideally fits medium–low-rainfall areas right through to high-rainfall areas. Blackleg resistance rating R (blackleg rotation groups A, B, D). Tested in NVT trials in 2012–14. Bred and marketed by Pacific Seeds.

Hyola® 575CL: mid-maturing Clearfield® hybrid. High oil content. Medium plant height. Blackleg resistance rating R (resistance groups B, F). Tested in SA NVT trials in 2010–14. Bred and marketed by Pacific Seeds.

Hyola® 971CL: late-maturing winter Grain n Graze Clearfield® hybrid. Extremely high biomass, good grain yield and oil content. Autumn and spring sowing grain-and-graze option for very-high-rainfall areas or irrigated zones. Provisional blackleg rating of R-MR (resistance group A). Not tested in NVT trials. Marketed by Pacific Seeds.

Results and discussion

Results for 50% flowering dates in 2014 (Table 2) show that when planted early, Hyola® 575CL reaches flowering considerably earlier (up to 2 weeks) than the other varieties tested. Hyola® 971CL, when planted in mid-April, failed to reach flowering prior to 1 October at all sites where it was trialled. The other varieties generally flowered within a few days of each other, with any differences becoming smaller by the last time of sowing.

Table 2: Dates of 50% flowering recorded for each variety and each time of sowing (TOS) at four sites in 2014

Location and variety		Date of 50% flowering			
	TOS:	15 April	30 April	13 May	29 May
Minnipa	ATR StingrayP	9 July	30 July	19 Aug.	6 Sept.
	Hyola® 559TT	31 July	10 Aug.	28 Aug.	6 Sept.
	TOS:	15 April[A]	5 May	2 June	19 June
Yeelanna	Pioneer® 44Y87CL	8 Aug.	7 Aug.	12 Sept.	15 Sept.
	Pioneer® 45Y88CL	1 Aug.	9 Aug.	12 Sept.	15 Sept.
	ATR GemP	1 Aug.	10 Aug.	15 Sept.	15 Sept.
	Hyola® 559TT	5 Aug.	18 Aug.	12 Sept.	15 Sept.
	Hyola® 575CL	10 July	11 Aug.	12 Sept.	19 Sept.
	Hyola® 971CL	–	–	–	–
	TOS:	14 Apr.	1 May	16 May	2 June
Hart	Pioneer® 44Y87CL	15 July	20 Aug.	2 Sept.	8 Sept.
	Pioneer® 45Y88CL	16 July	17 Aug.	4 Sept.	9 Sept.
	ATR GemP	6 July	10 Aug.	3 Sept.	10 Sept.
	Hyola® 559TT	6 July	8 Aug.	1 Sept.	8 Sept.
	Hyola® 575CL	29 June	2 Aug.	31 Aug.	6 Sept.
	Hyola® 971CL	2 Oct.	1 Oct.	4 Oct.	7 Oct.
	TOS:	14 Apr.	9 May	5 June	20 June
Lameroo	Pioneer® 44Y87CL	28 July	27 Aug.	8 Sept.	17 Sept.
	Pioneer® 45Y88CL	30 July	29 Aug.	13 Sept.	23 Sept.
	ATR GemP	27 July	27 Aug.	11 Sept.	19 Sept.
	Hyola® 559TT	26 July	25 Aug.	6 Sept.	16 Sept.
	Hyola® 575CL	8 July	28 Aug.	7 Sept.	19 Sept.
	Hyola® 971CL	–	–	–	–

[A]Sown and irrigated with 8 mm through dripper hose.

Table 3 shows the responses in grain yield to two different establishment rates (15 and 45 plants/m^2) at Yeelanna, Hart and Lameroo. At Yeelanna, the higher establishment rate (45 plants/m^2) produced significantly higher yields at each time of sowing. This reflects other work from the SAGIT canola establishment project on this soil type. At the Hart site, establishment rate became significant only at the third and fourth times of sowing (16 May and 2 June), where the higher seeding rate improved yields. This shows that although canola has great ability to compensate for poor establishment, in some situations, a poorly established crop will cost yield and this needs to be factored into management.

Table 3: Grain yield of canola comparing two different establishment rates (15 and 45 plants/m²) at three sites over four sowing times (TOS) in 2014

Location		Yield (t/ha)			
	TOS:	15 April[A]	5 May	2 June	19 June
Yeelanna	15 plants/m²	1.72	1.90	0.91	No harvest
	45 plants/m²	2.14	2.19	1.23	No harvest
	l.s.d. (P = 0.05)				0.17
	TOS:	14 Apr.	1 May	16 May	2 June
Hart	15 plants/m²	1.70	1.89	1.69	1.28
	45 plants/m²	1.70	1.94	1.94	1.62
	l.s.d. (P = 0.05)				0.17
	TOS:	14 Apr.	9 May	5 June	20 June
Lameroo	15 plants/m²	0.50	0.19	0.14	0.14
	45 plants/m²	0.43	0.22	0.18	0.11

[A]Sown and irrigated with 8 mm through dripper hose

Table 4 shows that the variety Pioneer® 45Y88CL yielded the highest at Yeelanna, Hart and Lameroo when planted in mid-April. The early May sowing showed very similar yield of all varieties, with the exception of ATR Gem⦶ and Hyola® 971CL. The Hart trial did not show any yield reduction when seeding was delayed to mid-May (third time of sowing) compared with early May; however, significant yield reductions occurred at the Wanilla site when comparing similar sowing times. This may reflect differences in soil water-holding capacity of these two soils. The results from these trials in the context of yield data from all South Australian NVT trials is shown in Table 5.

Table 4: Grain yield from canola sown at four sowing times (TOS) and five South Australian sites in 2014

Location and rainfall	Cultivar	Grain yield (t/ha)			
	TOS:	15 Apr.	30 Apr.	13 May	29 May
Minnipa (Jan.–Mar. 102 mm, Apr.–Oct. 290 mm)	ATR StingrayP	2.12	1.62	1.26	0.34
	Hyola® 559TT	1.63	1.51	1.12	0.43
	P-value				<0.001
	l.s.d. (*P* = 0.05)				0.18
	TOS:	30 Apr.	6 May	16 May	28 May
Wanilla (Jan.–Mar. 83 mm, Apr.–Oct. 399 mm)	Hyola® 575CL	1.41	1.49	0.91	0.65
	Pioneer® 45Y88CL	1.41	1.50	0.70	0.51
	P-value				<0.001
	l.s.d. (*P* = 0.05)				0.14
	TOS:	15 April[A]	5 May	2 June	19 June
Yeelanna (Jan.–Mar. 89 mm, Apr.–Oct. 346 mm)	Pioneer® 44Y87CL	1.96	2.06	1.38	No harvest
	Pioneer® 45Y88CL	2.26	2.17	1.13	
	ATR GemP	1.64	1.82	0.73	
	Hyola® 559TT	1.89	2.07	1.08	
	Hyola® 575CL	2.21	2.34	1.18	
	Hyola® 971CL	0.54	0.27	0.20	
	P-value				<0.001
	l.s.d. (*P* = 0.05)				0.30

Location and rainfall	Cultivar	Grain yield (t/ha)			
	TOS:	14 Apr.	1 May	16 May	2 June
Hart (Jan.–Mar. 84 mm, Apr.–Oct. 289 mm)	Pioneer® 44Y87CL	1.62	1.80	1.89	1.82
	Pioneer® 45Y88CL	1.98	1.96	1.89	1.42
	ATR GemP	1.29	1.52	1.56	1.15
	Hyola® 559TT	1.76	1.84	1.74	1.32
	Hyola® 575CL	1.49	2.06	2.05	1.61
	Hyola® 971CL	0.37	0.40	0.49	0.25
	P-value				<0.001
	l.s.d. (*P* = 0.05)				0.24
	TOS:	14 Apr.	9 May	5 June	20 June
Lameroo (Jan.–Mar. 62 mm, Apr.–Oct. 189 mm)	Pioneer® 44Y87CL	0.59	0.36	0.28	0.23
	Pioneer® 45Y88CL	0.72	0.31	0.24	0.12
	ATR GemP	0.46	0.12	0.08	0.10
	Hyola® 559TT	0.56	0.22	0.30	0.22
	Hyola® 575CL	0.51	0.25	0.23	0.13
	Hyola® 971CL	0.00	0.00	0.00	0.00
	P-value				<0.001
	l.s.d. (*P* = 0.05)				0.18

[A] *Sown and irrigated with 8 mm through dripper hose.*

Table 5: South Australian canola variety NVT trial of yield performance (2014, expressed as % of site average yield)

	LOWER EP		UPPER EP		YORKE PENINSULA		MID NORTH			SOUTH EAST				
	Mid		Early		Mid	Early	Mid			Early	Mid			
	2014		2014		2014		2014			2014				
Variety	Mt Hope	Yeelanna	Lock	Minnipa	Arthurton	Minlaton	Spalding	Riverton	Turretfield	Keith	Bordertown	Frances	Moyhall	
AV Garnet	99	88	96	No Trial	90	No Trial	82	No Trial	No Trial	76	73	85	97	Conventinal
AV Zircon	91	94	75		93		82			55	86	102	94	
Hyola 50	106	113	106		101		104			85	109	108	115	
Hyola 635CC	94	104	77		108		111			74	101	86	96	
Nuseed Diamond	100	102	146		109		122			210	132	121	112	
Victory V3002	94	97			99		98			-	99	98	86	
Site av yield (t/ha)	2.32	1.6	0.96		2.83		2.46			0.59	1.35	1.46	1.76	
LSD (%)	6	15	6		6		8			16	8	12	18	
Archer	99	91	-	-	100	105	104	89	94	No valid result	89	97	102	Clearfield
Hyola 474CL	99	107	106	110	97	102	97	109	103		-	-	-	
Hyola 575CL	98	111	107	110	99	109	95	107	103		85	92	94	
Hyola 577CL	95	96	-	-	96	-	103	105	105		77	88	104	
Pioneer 43Y85(CL)	-	-	88	-	-	93	-	-	-		-	-	-	
Pioneer 44Y87(CL)	99	103	101	96	99	103	101	97	95		97	111	96	
Pioneer 44Y89(CL)	102	102	116	109	98	108	105	106	103		122	101	109	
Pioneer 45Y86(CL)	101	97	-	-	100	-	98	86	97		108	100	92	
Pioneer 45Y88(CL)	98	93	-	-	102	-	103	93	98		91	103	93	
Site av yield (t/ha)	2.23	2.2	0.95	1.84	2.7	2.29	2.17	2.67	2.23		1.2	1.36	1.5	
LSD (%)	6	11	7	5	6	7	10	4	6		10	13	22	
ATR Bonito	-	-	91	95	97	94	104	103	93	No valid result	101	103	No valid result	Trisazine Tolerant
ATR Gem	96	96	-	-	96	97	-	100	99		92	100		
ATR Stingray	93	85	120	105	80	98	100	-	118		-	-		
ATR Wahoo	93	81	-	-	-	-	-	101	95		73	94		
Hyola 450TT	103	114	114	101	108	108	-	-	-		-	108		
Hyola 559TT	-	-	111	104	117	113	110	111	107		133	113		
Hyola 650TT	108	103	-	-	110	-	108	117	110		120	99		
Hyola 750TT	103	89	-	-	117	-	110	101	102		120	97		
Monola 314TT	-	-	-	-	-	-	93	87	96		99	114		
Monola 515TT	-	-	-	-	84	81	83	92	92		85	83		
Pioneer Atomic TT	-	-	104	93	-	107	106	90	-		-	-		
Pioner Sturt TT	95	95	84	91	-	97	-	-	-		-	-		
Site av yield (t/ha)	2.06	1.62	0.76	1.61	2.34	2.06	2.42	2.57	1.97		0.81	1.12		
LSD (%)	7	15	9	6	7	8	9	4	7		14	17		
Date sown	30 Apr	30 Apr	1 May	30 May	7 May	7 May	6 May	5 May	5 May	15 May	15 May	20 May	19 May	
Jan-Mar/ Apr-Oct rf	(82) 359	(80) 318	(32) 229	(96) 275	88 (322)	(87) 250	(82) 304	(99) 376	(137) 347	(40) 226	(30) 222	(67) 242	(57) 275	

*Comparisons cannot be made across chemistry types as the trials were not structured to allow this. (Source: GRDC/NVT).

Some of the differences in yields and plant development observed in the time-of-sowing trials can in part be explained by the drivers behind the development of each canola cultivar. There are three main considerations in the development of canola cultivars: vernalisation response, photoperiod response and basic temperature response. Each of these will play a different role in every variety.

Vernalisation affects canola from sowing to floral initiation. Varietal response to vernalisation will manifest as reduced time from sowing to floral initiation as well as a reduced number of leaves at floral initiation. Early sowing of canola into a relatively warm period (i.e. sowing in early April *v.* mid-May) is expected to lead to a delay in the accumulation of vernalisation, which will exacerbate the differences in flowering dates of varieties with different vernalisation requirements.

Varietal response to photoperiod occurs between emergence and floral initiation. Canola is a long-day plant, meaning that the duration from sowing to floral initiation is reduced in situations of extended daylight hours. In recent studies, varieties commonly responded to daylength in the range of 11–16 h. For canola plants emerging in mid-April after an early-April sowing, some of the photoperiod requirement could be met in autumn when daylength is longer than in mid-winter.

The basic temperature response is essentially the response of a variety to thermal time (degree-days) when both photoperiod and vernalisation requirements are met. Although there are differences in the basic temperature response amongst commercial varieties in terms of time taken to floral initiation, this is generally less important than the differences resulting from vernalisation or photoperiod response. The basic temperature response is, however, the main driver of development after floral initiation.

Using the data collected from the South Australian and New South Wales trials in 2014, we can draw some conclusions about how some of the varieties develop.

Hyola® 971CL has a high vernalisation requirement. When this variety was sown in mid-April in the low–medium-rainfall area of South Australia in 2014, flowering did not commence until the first week in October. Dry conditions through spring in all locations led to this variety being the lowest yielding in all trials.

Hyola® 575CL appears to have a relatively flat thermal-time requirement, regardless of when it is sown. This resulted in Hyola® 575CL being the first variety to commence flowering when sown early. Results from the first time of sowing in all trials show that the yield of Hyola® 575CL was lower than that of Pioneer® 45Y88CL, meaning that it was a disadvantage to plant Hyola® 575CL early in 2014. The variety description of Hyola® 575CL indicated it should have a mid-season maturity, similar to Pioneer® 45Y88CL.

For Pioneer® 44Y87CL, as sowing was delayed thermal-time requirement was reduced. Further research is needed to understand why this occurred but it may have been due to a greater vernalisation requirement of Pioneer® 44Y87CL than of Hyola® 575CL, with early sowing taking longer to accumulate vernalisation than later sowing dates. This may have helped Pioneer® 44Y87CL to avoid some damage from early frost events.

Information generated by trials such as this in the future will add value to other trial results such as NVT and help to explain differences in varietal adaptation and performance as a starting point to growing more profitable canola.

Conclusion

The manner in which each canola variety develops can have a large influence on the resulting yield when planted at different times and in different environments. The future challenge for this project is to develop and deliver information on new varieties in a way that is timely and relevant to growers and advisers. Growers and advisers will be able to use this information to aid selection of a suite of varieties suited to the sowing opportunities that most often occur in their district and to capitalise on early or delayed sowing opportunities as the seasons dictate. [8]

8 A Ware, R Brill, J Kirkegaard, S Noack, A Pearce, L Davis (2015) Canola growth and development—impact of time of sowing (TOS) and seasonal conditions. GRDC Update Papers, 10 February 2015, http://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2015/02/Canola-growth-and-development-impact-of-time-of-sowing-TOS-and-seasonal-conditions

FAQ

3.4 Targeted plant population

Crop establishment counts should be carried out within 4 weeks of emergence to review the success of the sowing operation, which will help to decide whether the seed rate or equipment needs to be adjusted for next year's crop. The impact of establishment pests (such as earth mites, aphids, slugs or soil-dwelling pests) can also be assessed at this time.

For narrow row spacing (up to 30 cm), use a square quadrat (0.5 m by 0.5 m, 0.25 m^2); for a wider row spacing, a 1-m ruler placed along the row is more convenient. Count as many sites as possible (minimum of 20) across a widely representative area of the whole crop.

In Victoria, ideal plant populations (no. of plants/m^2) are:

- 30–50 for the Mallee, Wimmera, northern, north-east districts
- 40–60 (up to 75 if sown late) for northern irrigation districts
- 50–75 for southern Victoria

In South Australia, optimum plant population (no. of plants/m^2) varies with rainfall:

- 40–70 for areas of low rainfall (250–350 mm)
- 50–80 for areas of medium rainfall (350–500 mm) [9]

Plant population, which is determined by sowing rate, germination percentage and establishment percentage, is an important determinant of biomass at flowering and therefore of yield.

Low-density crops can compensate with increased pod and seed production per plant; however, they are more vulnerable to disease, pests, weed competition and environmental stress. [10]

Experience has shown that crops with ~10 plants/m^2 can still yield to their water-limited potential.

Agronomist's view

Evenness of plant population, both within the row and across the paddock, is more important than having an ideal population. Where plant populations are low, plants compensate by producing extra branches. Sowing rate for open-pollinated varieties is generally 2–3 kg/ha, subject to seed size. Sowing rate for hybrids is usually 1.5–2.5 kg/ha, because of high seed costs.

Many growers have reduced the sowing rate for open-pollinated varieties to 2 kg/ha, but only after they have gained experience in the skills and machinery refinements required to produce consistent establishment of the crop under a range of seasonal conditions. The trend towards hybrids with superior seedling vigour over open-pollinated varieties is allowing experienced growers to reduce seeding rates to 1.5–2.0 kg/ha. Excessively high seeding rates, for example 6–8 kg/ha cause crops to grow too tall, with weak, spindly stems, making them susceptible to lodging in spring during flowering and pod development.

It is advisable to sow an extra 1.0–1.5 kg/ha when seedbed conditions are not ideal, such as when sowing late into cold, wet soils or when no-till sowing into dense stubbles. Within the recommended plant population range, it is better to have too

9 L Jenkins (2009) Crop establishment. Ch. 5. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

10 P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

many canola plants than too few, although high plant densities have been linked to an increased incidence of Sclerotinia stem rot.

Typically, about 40–60% of sown seeds establish as plants. However, if conditions are favourable, establishment can be as high as 80%. Check the seed size every year; it can vary depending on how well the seed crop finished in the previous spring. For *Brassica napus*, the range is 250,000–350,000 seeds/kg for open-pollinated varieties and 150,000–200,000 for hybrids. Table 6 shows the large difference in plant establishment rates for a given seeding rate between open-pollinated varieties and hybrids. [11]

Table 6: Number of plants established per m² from different sowing rates and establishment percentages of open-pollinated varieties of canola (based on 290,000 seeds/kg) and hybrids (based on 175,000 seeds/kg)

Sowing rate (kg/ha)	Establishment percentage:					
	40%	50%	60%	70%	80%	90%
Open-pollinated canola						
2.0	23	29	35	41	46	52
3.0	35	44	52	61	70	78
4.0	46	58	70	81	93	104
5.0	58	73	87	102	116	131
Hybrid canola						
2.0	14	18	21	25	28	32
3.0	21	26	32	37	42	47
4.0	28	35	42	49	56	63
5.0	35	44	53	61	70	79

Increasing the sowing rate increases competition between plants, creating thinner main stems and fewer, less productive branches. Reducing the sowing rate creates plants with thicker main stems and more branches, delays leaf-area development, reduces biomass at flowering, and ultimately reduces yield.

More information

AOF: Over the bar with better canola agronomy

AOF: Better oilseeds trial: Canola variety x row spacing x plant population trial (2009)

3.4.1 Calculating seed requirements

Correct seed rates are critical in ensuring that target plant density is reached. The calculation of seeding rates for canola is different from that for wheat.

Suppliers usually provide canola seed as number of seeds per kg (e.g. 200,000 seeds/kg). To determine the seeding rate based on this, the following formula assumes that plant density and germination are known:

Sowing rate (kg/ha) = (target plant density x 1,000,000)/(seeds/kg x expected germination)

More information

Seeding rate calculators

Pacific Seeds: Canola seed planting rate calculators

Example

Pioneer® 44Y84 has a seed count of 211,400 seeds/kg. We want to achieve a target plant density of 40 plants/m² and assume that 85% of the seeds will germinate.

Thus, the seeding rate = (40 x 1,000,000)/(211,400 x 85)

= 40,000,000/17,969,000

= 2.23 kg/ha [12]

11 L Jenkins (2009) Crop establishment. Ch. 5. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

12 BCG (2015) Calculating canola seeding rates. News article. Birchip Cropping Group, http://www.bcg.org.au/cb_pages/news/Thetimeforsowingcanolaisuponusmakingitimportanttorevisitourunderstandingonseedingrates.Gettingthisri.php

3.4.2 Row spacing

Canola is usually sown at spacings of 22.5–30.5 cm, with the adoption of stubble retention and no-till farming systems resulting in a trend to wider row spacing and the possibility of inter-row sowing using GPS guidance systems. Now there is a trend back to narrower row spacings (17.5–25 cm) for improved crop competition and yield potential in cereals. Precision planting equipment also makes this possible.

Experiments in southern New South Wales have shown that widening row spacing in canola does appear to reduce yield when the row space is increased to 35 cm. [13] Densities as low as 15 plants/m^2, if consistent across a paddock, can still result in profitable crops when sown early and plants have time to compensate. Seed size varies between and within varieties and hybrids. Check seed size to calculate the correct number of seeds to be sown per m^2.

Establishment can be significantly reduced by sowing too deep, sowing late into cold, wet soils, and no-till sowing into dense stubble. Use a higher seed rate, consider sowing the seed at a shallower depth, or select a variety or hybrid with high vigour in these situations. Hybrids are generally more vigorous than open-pollinated varieties, primarily because of larger seed size. Where seed is retained on-farm, grade the seed and keep the largest seed for sowing.

More information

Research paper: Growing canola on raised beds in south-west Victoria

High plant densities, combined with suitable environmental conditions, can increase the risk of Sclerotinia stem rot during flowering. High plant densities can also increase the risk of moisture deficit during grainfill in dry spring conditions, potentially reducing yields. [14]

3.4.3 Managing low plant establishment

Plant populations as low as 20 plants/m^2 can still produce good yields; however, such crops are more susceptible to weed competition. In addition, the variable pod development on these plants makes timing of windrowing difficult to determine, especially if germination has been staggered. At densities <15 plants/ m^2, the crop is likely to be patchy and lower yielding. Before re-sowing or abandoning a crop, always check with an experienced agronomist or grower, because plants can compensate remarkably well and the yield potential may be equal to, or higher than, a better established but later sown crop. [15]

3.5 Sowing depth

Where conditions allow, aim to drill seed through the main seed box to 1.5–3 cm deep and as deep as to 5 cm in self-mulching clays. Where there is moisture below 1.5–3 cm, a reduced but viable establishment may still be achieved by sowing deeper, provided large seed is sown. This strategy can be used to sow some of the crop on time in seasons of good summer rainfall followed by drying surface seedbeds in autumn. Success with this strategy depends on soil type, soil structure and the amount and timing of follow-up rainfall. [16]

Sowing depth has a major influence on seedling vigour, which subsequently affects seedling establishment and crop performance.

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13 J Edwards, K Hertel (2011) Canola growth and development. PROCROP Series. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/516181/Procrop-canola-growth-and-development.pdf

14 P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

15 L Jenkins (2009) Crop establishment. Ch. 5. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

16 P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

Deep seed placement increases the risk of failed emergence. Deeper sowing reduces light availability, and the hypocotyl (the shoot that emerges from the seed) responds to this by elongating, reducing the chance of seedling emergence. Seeds planted >2 cm deep or into >5 t/ha of stubble develop elongated hypocotyls. This elongation depletes the seed reserves more quickly than in seeds with shorter hypocotyls. The longer hypocotyls are also thinner, with decreased tissue density, and are more susceptible to mechanical damage and collapse.

Plants with longer hypocotyls have smaller root systems, smaller leaf area from an early stage, and less leaf and root biomass. Leaves are slower to expand, which reduces dry matter. As a result, plants that allocate more resources to the hypocotyls at the expense of leaves and roots have lower relative growth rates. [17]

This effect can contribute to slower growth of plants in surface-mulch treatments, and the slower growth can be compounded by low temperatures.

More information

AOF: Over the bar with better canola agronomy

DAFWA: Deep seeding in canola

3.6 Sowing equipment

Canola can be sown by using no-till techniques and most canola is now sown into retained stubble with a disc or knifepoint–press-wheel system. Stubble handling is more difficult in a tine system but growers are adapting by mulching stubbles after harvest, inter-row sowing or using double-break crops (pulse then canola).

When sowing into cereal stubble, ensure that straw and header trash is pushed away from the sowing row. Stubble covering the row can reduce canola emergence and early plant growth, to reduce yield significantly. Use rollers, cultipackers or press-wheels to improve seed–soil contact where appropriate, ensuring that the pressure applied by these devices is low. [18]

Sow seed through the main seed box or small seeds box of standard wheat-sowing equipment. The air-seeder or combine should be in good condition and the level adjusted (from side to side, front to back, and tine to tine) to ensure sowing at a uniform depth. Regulate groundspeed to avoid tine bounce, which will cause an uneven sowing depth. Diffusers are fitted to the sowing tines of air-seeders to stop seed from being blown from the seed row. A maximum sowing speed of 8–10 km/h is suggested for most soils.

Several options are available to level the seedbed and help to compact moist soil around the seed. These include the use of press-wheels or a rubber-tyred roller, coil packers (flexi-coil roller), or trailing light harrows or mesh behind the planter. Knifepoints with press-wheels are the preferred option. Avoid heavy harrows with long tines and prickle chains because they can disturb seed placement.

The seed box on most modern air-seeders and combines can be calibrated for low seeding rates. Check calibrations from year to year, because seed size can change and affect actual sowing rate.

Checklist for sowing equipment:

- Ensure accurate calibration for sowing rate.
- Ensure even wear of points for accurate seed placement.
- Use narrow points to reduce ridging.
- Keep front and rear rows of tines level.
- Sow slower rather than faster, to avoid overly shallow depth, seed bounce, or increased soil-throw by tines, which effectively results in front-tine seed being sown too deep.

17 L Jenkins, R Brill (2013) Improving canola profit in central NSW: effect of time of sowing and variety choice. GRDC Update Papers 25 February 2013, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/02/Improving-canola-profit-in-central-NSW-effect-of-time-of-sowing-and-variety-choice

18 J Edwards, K Hertel (2011) Canola growth and development. PROCROP Series. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/516181/Procrop-canola-growth-and-development.pdf

More information

[NSW DPI: Row spacing of winter crops in broad scale agriculture in southern Australia]

[http://www.Research paper: Canola in rotations]

- Ensure level ridges behind the seeder. If using harrows, heavy harrows may be too severe and finger harrows too light.
- Avoid seed–superphosphate mixes that contain excess rates of nitrogen. [19]

3.6.1 Alternative sowing techniques

The use of wider row spacing to conserve moisture in low-rainfall areas has seen an expansion of the areas in which canola is grown. Other techniques, such as dry sowing, aerial sowing and the use of raised beds, have been further refined, which can reduce sowing delays caused by unseasonably dry or wet conditions. [20]

19 L Jenkins (2009) Crop establishment. Ch. 5 In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

20 L Jenkins (2009) Crop establishment. Ch. 5 In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf