Agronomic performance of new open-pollinated and hybrid canola cultivars to time of sowing in Western Australia

Mohammad Amjad[1] and Peter F White[2]
[1] Department of Agriculture and Food Western Australia, Centre for Cropping Systems, PO Box 483, Northam WA 6164 Australia, mamjad@agric.wa.gov.au
[2] Department of Agriculture and Food Western Australia, 3 Baron-Hay Court, South Perth WA 6151 Australia, pfwhite@agric.wa.gov.au

ABSTRACT

Canola is currently the most important broadleaf break crop commercially grown in Western Australia. The time of sowing experiments were conducted in 2008 to evaluate the performance of new open-pollinated and hybrid cultivars for improving grain yield, oil and the local adaptation in three cropping environments. Trials were located in the central agricultural region (CAR) at Meckering, the northern agricultural region (NAR) at Eradu and the southern agricultural region (SAR) at Esperance.

Overall the new hybrid canola cultivars (Hyola 60 and 45Y77) produced greater than 20% higher yields than the open pollinated canola. Generally canola sowed early, at the break of the season, yielded more than the late sown canola. This was previously reported by Farre et al. (2002) in Western Australian environments. Mid to late maturing open-pollinated varieties (such as CB Argyle, Flinders TTC, Rottnest TTC, Thunder TT) performed similar to the control variety (ATR Stubby) when sown either earlier at the break of the season or later at the end of May. New short season quick maturing canola varieties (i.e., ATR Cobbler, CB Boomer, Hyola 60 and 45Y77) gave higher yields compared to the control when sown later at the end of May; however, these varieties were still profitable (yielding between 0.8 t/ha to 1.20 t/ha) given the high prices on offer in 2008. Most cultivars produced oil contents over 42 % and met the minimum target standards for delivery. Research results may assist growers to make decisions about variety choice both in terms of replacing old varieties and in maintaining a mix of varieties with a range of maturities (including hybrids) to reduce production risks.

KEYWORDS: Varieties, grain yield, oil content, agronomy, date of sowing

INTRODUCTION

Canola is currently the most important broadleaf break crop commercially grown in Western Australia. It is the third largest grain crop, by area, grown in Western Australia after wheat and barley (ABS 2009). During 2008, canola production achieved a record 1.1 million tons from a sown area of 620,000 ha.

Sowing date plays a fundamental role in improving canola yield and oil content particularly in winter-dominant rainfall environments. In general early sowing at the break of season (in April and May) produced higher yields than late sowing (Robertson et al. 2004). Farre et al. (2002) estimated the yield reduction with delayed canola sowing of 3.3 % per week in 700mm annual rainfall to 10.1% per week in 350 mm rainfall environments by using two years field data and simulation model data in Western Australia.

Herbicide-tolerant, open-pollinated varieties of canola are widely grown in Western Australia (90% of the total crop) and generally recognised as a viable option for weed management in the cropping systems (Hashem et al. 2008). However, new hybrid canola cultivars have recently been introduced in medium to high rainfall environments. There is limited information available on how these new cultivars of hybrid canola will respond to time of sowing and environment in comparison to open-pollinated. Temperature and rainfall are known to greatly influence the time

of sowing responses of new cultivars both for yield and oil quality (Amjad et al. 2008)... The objective of this research is to evaluate the performance of new open-pollinated and hybrid cultivars at two time of sowing for improving the grain yield, oil and local adaptation in Western Australian environments.

MATERIALS AND METHODS

During 2008, a combination of 20 cultivars including 16 open-pollinated and 4 hybrid cultivars were at two times of sowing into cereal stubbles at each of three environments: the central agricultural region (CAR) at Meckering (Longitude: 117.00911 E Latitude: 31.62864 S), the northern agricultural region (NAR) at Eradu (Longitude: 114.58443 E Latitude 28.41130 S) and the southern agricultural region (SAR) at Esperance (Longitude: 121.82129 E Latitude: 33.68574 S). These cultivars could also be grouped into: three herbicide categories 12 triazine tolerant (TT), 6 Clearfield Imididazolinone tolerant (CL) and 2 non-herbicide tolerant (NT). The cultivars comprised a range of maturity and disease tolerances (ratings) which have previously been described by Amjad, (2009) and listed on the National Variety Testing website (www.nvtonline.com.au).

The trial design at Meckering was a split-split plot design, with herbicide tolerance as main plots, time of sowing as sub-plots and cultivars as sub-sub-plots. At Eradu and Esperance, the trials were managed as a conventional crop (non herbicide tolerant) for in-crop weed control. There were three replicates in three banks. Time of sowing 1 was on the early break of the season in each environment and the subsequent time of sowing 2 was 3-4 weeks later. All trials were treated with a knockdown herbicide prior to seeding. A basal fertilizer (Agras, 16 kg N, 9 kg P and 14 kg S) was applied at seeding at a rate of 100 kg/ha. Urea was topdressed at a rate of 100 kg/ha (46 kg N/ha) 4 to 6 weeks after sowing. Trials were monitored and controlled for weeds, pests and diseases as necessary throughout the growing season.

RESULTS AND DISCUSSION

Growing season

The 2008 season at Meckering started with an early seasonal break in April followed by a dry May and then wet June and July. Meckering received 270 mm growing season rainfall (May to October) with a total of 378 mm for the year. The season at Eradu started with seasonal break in early May followed by dry months of June and July. Eradu received 272 mm growing season rainfall (May to October) with a total of 427 mm for the year. The season at Esperance started with late seasonal break in May followed by a dry period with sandblasting winds extending well into June. As a result germination and establishment of the plants was poor. Esperance received 388 mm growing season rainfall (May to October) with a total of 427 mm for the year. Mild temperatures and good finish to the season improved canola production in all three environments.

Crop establishment

Crop germination, emergence and early vigour were reasonable for all cultivars (scored visually 6 to 8) in the trials at Meckering. There was a significant difference in plant establishment between cultivars and time of sowing; however the plant establishment mostly met the target plant population 40 to 90 plants/m^2. Comparatively, plant population was lower (45 plants/m^2) at time of sowing 1 compared to 96 plants/m^2 at time of sowing 2 (Table 1). The interaction between cultivars and time of sowing was significant; however, there was no difference in plant population from the control variety ATR Stubby when sown on 29 April. As a result of those tough seasonal conditions (lack of rainfall) in May and June at Eradu, canola germination and establishment were adversely affected and thus resulted in very patchy, staggered and uneven plant population for all cultivars (data not shown). At Esperance, there was no difference in plant establishment between cultivars and time of sowing (interaction was not significant); however the main effects of cultivars and time of sowing were significantly different (data not shown). Comparatively plant population was lower (23 plants/m^2) at first times of sowing compared to 30 plant/m^2 at 2nd time of sowing.

Grain yield

At Meckering, the variety mean yields were higher in early sowing (TOS1 - 29 April) and decreased for the later sowing (TOS2 - 28 May, Table1). The average yield loss was 1.5 % (23 kg) for every day delay in sowing from the break of the season April 29 to May 28 sowing. It was observed in the trial that herbicide tolerant TT and CL canola had less weed and better weed control compared to non- herbicide tolerant NT canola.

At Eradu, the main effects of the cultivars and time of sowing were significant for grain yield (data not shown). The interaction between cultivars and time of sowing was non significant at 5% level. The variety mean yields were higher in early May sowing (1.54 t/ha) and decreased in the late May sowing to 0.58 t/ha. The control variety ATR Stubby yielded 0.74 t/ha at Eradu. Six new cultivars including the CL hybrids (45Y77 and 46Y78), NT hybrids (Hyola 60 and Hyola 61) and normal open pollinated canola (ATR Cobbler and CB Pilbara) had out-yielded the control variety ATR Stubby. All other cultivars yielded similar to ATR Stubby. The analyses of yield results had indicated a comparatively higher coefficient of variation (CV: 35.4 %) in the data set possibly due to very patchy and staggered crop establishment and thus produced variable yields.

The good early spring rains assisted in podding and grain filling but wet weather at the finish of the season had delayed harvest at Esperance. Cultivars did not respond to time of sowing and yielded similar (2.0 t/ha) for both mid May and early June sowing, however the mean cultivar yields were different (data not shown). The interaction between cultivars and time of sowing for grain yield was also not different. Eight new cultivars including the CL hybrids (46Y81, 45Y77 and 46Y78), NT hybrids (Hyola 60 and Hyola 61) and normal open pollinated canola (46C76, Warrior CL, Flinders TTC) out-yielded the control variety ATR Stubby.

Table 1. Plant population and grain yield for different cultivars at two times of sowing in the central agricultural region (CAR) at Meckering

	TOS1 29 April		**TOS2 28 May**		**Average**	
Open-pollinated cultivars	Plant/m^2	Yield, t/ha	Plant/m^2	Yield, t/ha	Plant/m^2	Yield, t/ha
ATR Cobbler	38.8	1.72	103.7	1.12a	71.3	1.72
ATR Stubby*	41.6	1.69	92.2	0.79	66.9	1.24
Bravo TT	42.3	1.62	76.6	0.91	59.5	1.27
CB Argyle	52.7	1.66	108.2	0.69	80.5	1.18
CB Boomer	35.7	1.16[b]	80.1	1.11[a]	57.9	1.16
CB Pilbara	53.7	1.49	94.7	0.9	74.2	1.20
CB Scaddan	49.9	1.25b	76	0.91	63.0	1.08
CB Tanami	41.9	1.70	100.6	0.95	71.3	1.33
CB Telfer	57.6	1.49	129.1[a]	0.69	57.6	1.09
Flinders TTC	44.7	1.70	91.9	0.65	68.3	1.18
Rottnest TTC	37.8	1.65	109.9	0.83	73.9	1.24
Thunder TT	39.5	1.62	84.3	0.87	61.9	1.25
45C75	59.4	1.33[b]	112.3[a]	0.55	59.4	0.94
46C76	38.2	1.62	119. 6[a]	0.62	38.2	1.12
Rocket CL	42.8	1.30[b]	97.3	0.88	70.1	1.09
Warrior CL	42.8	1.6	98.4	0.83	70.6	1.22
Hybrid cultivars						
45Y77	37.6	1.76	60.2b	1.26[a]	37.6	1.76
46Y78	47.3	1.75	85.9	1.07	66.6	1.41
Hyola 60	36.2	1.96	55. 7b	1.25[a]	36.2	1.96
Hyola 61	39.7	2.09[a]	92.5	1.05	66.1	1.05

Average	*44.7*	*1.56*	*96.6*	*0.87*	70.7	1.22
	Cultivars	*Establishment: 13.5*		*Yield:*	*0.23*	
	TOS	*3.9*			*0.07*	
Lsd (0.05)	*Cultivars*TOS*	*19.1*			*0.32*	
	CV	*16.80%*			*16.30%*	

* The control variety, i.e., ATR Stubby
- Superscript "a" indicates variety (s) is significantly better performing than the control variety
- Superscript "b" indicates variety (s) is significantly less performing than the control variety
- LSD "19 plants/m^2" was used for plant population as the interaction between Cultivar*TOS was significant at 5% level).
- LSD "0.32 t/ha" was used for yield as the interaction between Cultivar*TOS was significant at 5% level).

Oil content

Cultivars and time of sowing had influenced the final oil content of the seed at all three locations. Most cultivars produced oil contents over 42 % (data shown from Meckering in Table 4); however, cultivars did differ for oil yield with time of sowing. Early sowing at the break of season gave on average 3.6% higher oil compared to the late May sowing.

Table 2. Oil content (%) different cultivars with time of sowing in the central agricultural region (CAR) at Meckering.

	TOS1 – 29 April	TOS2 - 28 May	Average
Open-pollinated cultivars			
ATR Cobbler	44.9	42.0	43.5
ATR Stubby*	44.6	39.8	42.2
Bravo TT	46.4	43.0	44.7 [a]
CB Argyle	47.2	42.8	45.0 [a]
CB Boomer	43.9	41.6	42.8
CB Pilbara	45.4	42.0	43.7 [a]
CB Scaddan	44.2	39.4	41.8
CB Tanami	44.4	40.7	42.6
CB Telfer	46.1	41.9	44.0 [a]
Flinders TTC	45.4	40.7	43.1
Rottnest TTC	45.4	40.1	42.8
Thunder TT	45.6	41.2	43.4
45C75	46.2	42.5	44.3
46C76	45.2	41.2	43.2
Rocket CL	46.3	43.4	44.9 [a]
Warrior CL	46.2	43.0	44.6 [a]
Hybrid cultivars			
45Y77	46.3	43.1	44.7 [a]
46Y78	46.1	43.3	44.7 [a]
Hyola 60	45.5	45.5	45.5 [a]
Hyola 61	46.1	42.8	44.5 [a]
Average	*45.8*	*42.2*	*44.0*
Lsd(0.05)	*Variety*	*1.53*	
	TOS	*0.42*	

	*Variety*TOS*	*ns*
CV		*3.0%*

* The control variety, i.e., ATR Stubby

- Superscript "a" indicates variety (s) is significantly better performing than the control variety
- No cultivar produced lower oil than the control
- LSD "0.1.53% and 0.0.42%" were used for oil content to compare the main effects of cultivars and TOS (as the interaction between Cultivar*TOS was not significant at 5% level).

CONCLUSION

Canola cultivars responded and performed differently to time of sowing in Western Australia. Hybrid canola generally yielded better than the open pollinated canola in all three environments. Canola cultivars yielded the highest both for grain and oil when sown early at the break of the season. Grain yield decreased with the later sowing at the end of May at two out of three locations. At Esperance, cultivars differed in yield but did not respond to time of sowing. This might be due the late start of the season and sandblasting issues with early emerged seedlings.

These research results may help growers to make better management decisions to replace their existing varieties with new varieties and reduce production risks by having a mix of two to three new herbicide tolerant canola including hybrids in the cropping systems. Further agronomic testing of new cultivars across seasons is required in different cropping systems.

ACKNOWLEDGMENTS

This research was jointly funded by the Department of Agriculture and Food Western Australia (DAFWA) and the Grains Research and Development Corporation (GRDC). The staff at DAFWA Research Stations provided the technical support for managing the trials throughout the growing season. The contributions of the break crop technical staff Andy Sutherland and Mike Baker for collecting plant count and flower data are acknowledged.

REFERENCES

Australian Bureau of Statistics, 2009: Agricultural Commodities, Australia 2007-08. Catalogue 7121.0.

Amjad, M., Sutherland, A. and P. Fels, 2008: How late can I sow canola in 2008? In Agribusiness Crop Update: Lupins, Pulses and Oilseed Updates (Ed W Parker) p 61. Department of Agriculture and Food Western Australia, South Perth.

Amjad, M., 2009: Canola variety guide Western Australia 2009. Department of Agriculture and Food Western Australia Farmnote No 346, February.

Angus, J. F., van Herwaaden, A.F. and G. N. Howe, 1991: Productivity and breakcrop effect of winter growing oilseeds. Australian Journal of Experimental Agriculture 31, 669-77.

Farre, I., Robertson, M. J., Walton, G. H. and S. Asseng, 2002: Simulating phenology and yield response of canola to sowing date in Western Australia. Australian Journal of Agricultural Research 53, 1155-1164.

Hashem, A., Amjad, M. and V. Stewart, 2008: Weed control in herbicide-tolerant canola. Department of Agriculture and Food Western Australia Farmnote No 291, April.

Kierkegaard, J. A., Gardner, P. A., Angus, J. F. And E. Koetz, 1994: Effect of Brassica crops on the growth and yield of wheat. Australian Journal of Agricultural Research 45, 529-45.

Robertson, M. J., Holland, J. F. and R. Bambach, 2004: Response of canola and Indian mustard to sowing date in the grain belt of north-eastern Australia. Australian Journal of Experimental Agriculture 43-52.