Brassica juncea and canola *(Brassica napus)* in low rainfall South Australia - trials over the past several years, blackleg and new varieties

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RESEARCH

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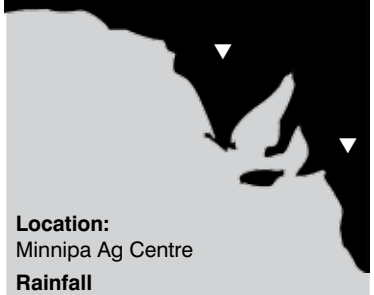

Location:
Minnipa Ag Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 250 mm
2010 Total: 404 mm
2010 GSR: 252 mm
Yield
Potential: 2.72 t/ha (C)
Actual: 2.41 t/ha
Paddock History
2010:Barley
2009: Wheat
2008: Wheat
Soil Type
Brown loam
Plot size
10 m x 1.48 m x 3 reps

Location:
Lameroo
Rainfall
2011 Total: 558 mm
2011 GSR: 189 mm
Yield
Actual: 1.4 t/ha
Paddock History
2010: Wheat
Soil Type
Sandy loam
Yield Limiting Factors
Dry conditions during late grain fill

Key messages

- ***Brassica juncea* has the potential to be grown on a substantial area of low rainfall cropping country in South Australia with a likely area of up to 165,000 ha per year.**
- **Production may be expected to vary from year to year based on the timing of the seasonal break.**
- **Previous trials have shown that under low yield conditions, *B. juncea* can produce higher grain yields than canola.**
- **In the past two years with mild, wet conditions canola has performed relatively better than *B. juncea.***
- **We are starting to see more blackleg occurring in low rainfall regions as the area sown to canola increases. It is not yet enough to cause problems but we need to keep our eye on it.**
- **Even more canola varieties have been released that may be good options in low rainfall areas.**

1. *Brassica juncea* compared to *Brassica napus*

Why do this research?

Research into *Brassica juncea* in Australia has occurred over the past 25 years with the aim of developing an oil crop with equivalent oil quality to canola (Burton et al., 2003). *B. juncea* has many characteristics that should make it a viable crop in lower rainfall areas of Australia. These include good early vigour, early flowering, good blackleg tolerance, shatter tolerance and higher grain yields than canola when site yields are 1.2 t/ha or less. Both canola and *B. juncea* have ready acceptance by farmers in lower rainfall areas as both crops have been shown to fit into cropping rotations and act as disease break crops in cereal production (Potter et al., 1997; Angus et al., 1999). Interest in *B. juncea* in Australia centres around three uses: as a food crop equivalent to canola, as a condiment crop and also as a feedstock for biodiesel. The first canola quality *B. juncea* cultivars were commercialised in 2008 and have low erucic acid, low glucosinolates and oleic acid levels of greater than 60%. This paper outlines recent data comparing *B. juncea* with *B. napus* and discusses where *B. juncea* could be grown in South Australia.

How was it done?

A series of trials was sown at Lameroo and Minnipa in South Australia during 2008-2010. These trials included investigations into nitrogen application rates. Trials were successful at Lameroo in all years. Plot size was 8 m long by 8 rows at 15 cm row spacing. Three replications were used. The cultivars tested were 44C79 and OasisCL. Dry matter was measured during the growing season and also at harvest. Time of sowing trials were successfully conducted at Minnipa in 2009 and 2010 following drought in 2008. At both sites grain yield was determined by machine harvest.

What happened?

Seasons at Lameroo were characterised by a hot dry finish in 2008, high rainfall in 2009 and 2010, April to October rainfall being 168, 269 and 231 mm respectively. At Minnipa, drought in 2008 was followed by high rainfall in 2009 and 2010, April to October rainfall being 139, 333 and 386 mm respectively.

However, trials at Minnipa in 2010 were not sown until late May due to the late break.

At Lameroo, grain yields in the N application rate trials averaged 0.32, 0.75 and 0.83 t/ha in 2008-2010 respectively. Only in 2009 was there a significant response to nitrogen so mean data were used in Table 1 for 2008 and 2010 and the grain yield @ 60 kg N/ha for 2009. The dry matter accumulated at stem elongation was similar for 44C79 and OasisCL for all three years (Table 1). By flowering, 44C79 produced greater dry matter than OasisCL in 2008 and 2009 but similar in 2010. Similarly, at maturity, total dry matter was comparable for both cultivars but was reduced by dry hot conditions in 2008. Dry matter in 2010 was much higher than other years (Table 1) due to cool conditions in spring. Harvest index (HI) varied greatly between years. The hot dry conditions in 2008 resulted in very low HI (mean 0.12). In 2009, HI was similar for 44C79 and OasisCL (mean 0.25) but in 2010 where high dry matter was measured the HI was lower than expected. This resulted in a grain yield measured by plot harvester of 1.05 t/ha for 44C79 and 0.71 t/ha for OasisCL.

Table 1 Dry matter (g/m²), measured at different growth stages and harvest index for canola (44C79) and juncea (OasisCL) at Lameroo in 2008-2010

Year	Elongation DM (g/m²)		Flowering DM (g/m²)		Harvest DM (g/m²)		HI	
	44C79	OasisCL	44C79	OasisCL	44C79	OasisCL	44C79	OasisCL
2008	145	100	389	216	264	289	0.13	0.11
2009	124	119	363	201	377	430	0.26	0.24
2010	122	119	361	311	797	790	0.18	0.15

Table 2 Grain yield (t/ha) of canola and juncea at Minnipa in 2009

Entry	TOS 1*	TOS 2*	TOS 3*
Canola			
Hyola 50	2.74	2.52	1.83
Tarcoola	2.56	2.19	1.47
44C79	2.33	2.01	1.26
Juncea			
Dune	2.02	1.56	0.94
JC6019	2.13	1.63	1.17
Sahara CL	1.88	1.20	0.66
Oasis CL	2.33	1.73	1.09
SARDI515M	2.37	1.93	1.36
Site Mean	**2.30**	**1.85**	**1.22**
CV%	7.52	6.88	7.14
LSD (P=0.05)	*0.202*	*0.146*	*0.102*

** TOS 1, 3 May, TOS 2, 27 May, TOS 3, 11 June*

Table 3 Grain yield (t/ha) of canola and juncea at Minnipa in 2010

Entry	TOS 1*	TOS 2*	TOS 3*
Canola			
44C79	1.46	1.58	1.29
Hyola 50	1.62	1.70	1.58
Tarcoola	1.54	1.65	1.44
Juncea			
Oasis CL	1.13	1.05	0.84
Sahara CL	1.01	1.01	0.98
SARDI515M	1.24	1.21	1.00
Site Mean	**1.33**	**1.37**	**1.19**
CV%	6.06	4.60	8.92
LSD (P=0.05)	*0.097*	*0.069*	*0.121*

** TOS 1, 27 May, TOS 2, 11 June, TOS 3, 24 June*

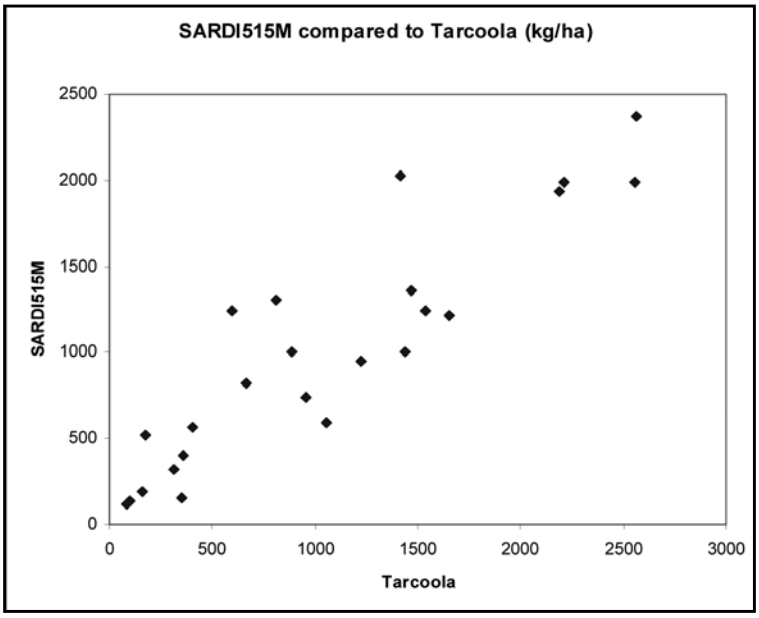

Figure 1 Comparison of grain yield of SARDI515M* (B. juncea) *with Tarcoola* (B. napus) *over a range of sites

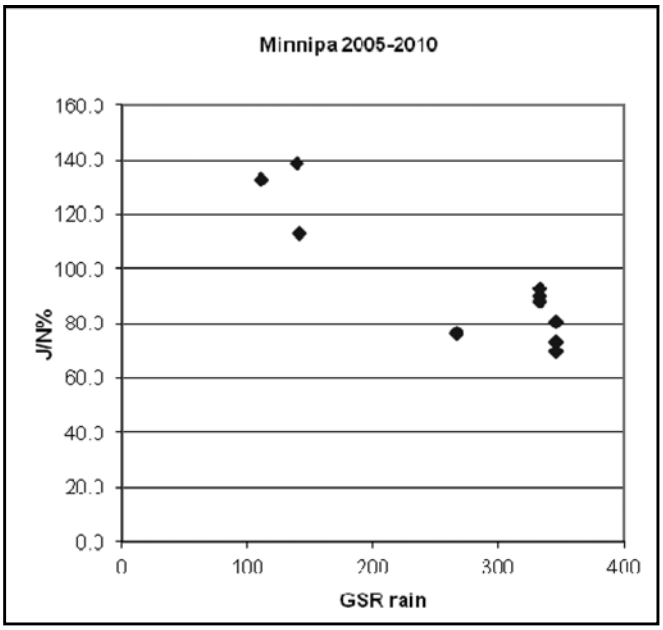

Figure 2 Relationship between yield of* B. juncea *and* B. napus *at Minnipa as affected by different amounts of growing season rainfall

Time of sowing trials were conducted at Minnipa in all three years but drought resulted in crop failure in 2008. Trials sown in 2009 and 2010 are detailed in Tables 2 and 3. In both years, canola produced higher grain yields than juncea (Tables 2 and 3).

Brassica juncea has often been shown to produce higher grain yields than *B. napus* in lower rainfall conditions, especially when grain yields achieved have been less than 1.2 t/ha. However, at Lameroo, in 2010 canola produced higher grain yields than juncea and similar grain yields in 2008 and 2009 where site mean yield was 0.32 and 0.75 t/ha respectively. At Minnipa, in the time of sowing trials, high grain yields were achieved and canola did produce higher yields than juncea. This would be expected as above average rainfall ensured high yields. However, at the late (June) sowings in both years the juncea did not perform as well as canola. The relatively good performance of canola in 2009 and 2010 may be due to the wet cool conditions of both years. Such conditions have not been experienced for a long period of time and are regarded as unusual in the low rainfall zone of SA. While the harvest indices of both crops were highly variable over the three years of trials, the HI achieved in 2010 was particularly low given the good season. The most likely reason could be the dry conditions after mid September but it appears that juncea was worse affected than canola. Frost damage was not noted so is unlikely to have caused the low HI.

Data from a range of trials has shown that *B. juncea* can produce higher grain yields than B. napus at low yield levels (Figure 1). The main exceptions were in northern NSW where *B. juncea* was better adapted. Data from Minnipa (Figure 2) showed that the relative yield performance of *B. juncea* was higher than *B. napus* when growing season rainfall was less than 200 mm. A range of sites was used to determine the effect of growing season rainfall on grain yield. For SARDI515M the relationship was 6.24 GSR - 592.66 r^2=0.69, for Tarcoola the relationship was 7.79 GSR - 856.45 r^2= 0.78.

Table 4 Area (ha) of crop types sown in recognised low rainfall areas of South Australia in 2010 Source: PIRSA crop reports

Region	Total Cereal (ha)	Total Pulse (ha)	Total Brassica (ha)
Western Eyre Peninsula	565,000	7,200	1,500
Eastern Eyre Peninsula	470,000	11,200	3,000
Upper North	360,000	40,000	13,000
Northern Murray Mallee	260,000	1,500	3,000
Southern Murray Mallee	241,000	2,000	6,000
Total low rainfall	**1,896,000**	**61,900**	**33,500**

The area of a range of crop types grown in recognised low rainfall areas of South Australia was determined in 2010 (Table 4). Total break crops make up a very small component of the total area cropped.

Based on current rotations, if *B. juncea* could be grown on 10% of the total cereal growing area in the low rainfall winter cereal zones, the production area for Australia would be over 600,000 ha (Norton et al., 2005). Table 4 shows the large area sown to cereals in the low rainfall zone of South Australia and the very low area sown to the cereal disease break crops whether they are a pulse or a Brassica. If only 10% of this total crop area was sown to a cereal disease break crop then at least 200,000 ha could be grown.

In South Australia, we have estimated that up to 165,000 ha could be grown at maximum uptake of *B. juncea.* In order to achieve this uptake, additional herbicide tolerant types will be needed and improved grain yield and quality will also be necessary to compete with *B. napus*. With the further development of improved *B. juncea* it is likely that this crop will increase in area up to this estimation and provide farmers with another crop that can fit into rotations with good economic returns and also provide a disease break for the following cereal crop. Production of Brassica crops in the low rainfall zone will still be expected to vary from year to year, however, as a late break to the season would be expected to reduce the area sown in that year due to the reliance on good spring conditions to get competitive yields.

What does this mean?

Brassica juncea has the potential to be grown on a substantial area of low rainfall cropping country in South Australia with a likely area of up to 165,000 ha per year. However, production may be expected to vary from year to year based on the timing of the seasonal break. Previous trials have shown that under low yield conditions, *B. juncea* can produce higher grain yields than canola. However, in the past two years with mild, wet conditions canola has performed relatively better than *B. juncea.*

Table 5 Mean internal infection and % of plants with more than 50% internal infection at 16 paddocks in the southern Mallee 2011

Location	Rating 2011	Variety	Mean % internal infection	% plants with more than 50% internal infection
Parilla	MS-S	Tanami	17.5	12
Pinnaroo	MS	43C80	22.1	12
Pinnaroo	MS	43C80	13.9	6
Pinnaroo	MS	44C79	26.7	16
Pinnaroo	MS	44C79	21.7	10
Lameroo south west	MS	44C79	18.7	14
Lameroo south west	MS	44C79	5.3	0
Lameroo south west	MS	44C79	11.0	6
Parilla north	MS	44C79	19.4	18
Parilla north	MS	Scaddan	2.6	0
Lameroo west	MR-MS	44Y84	11.8	8
Lameroo west	MR-MS	45Y82	18.2	12
Lameroo south west	MR	Fighter TT	5.1	6
Parilla	MR	Hurricane TT	3.2	0

2. Blackleg in canola in lower rainfall areas

A survey was conducted of canola crops in the southern Mallee in October 2011 to investigate the levels of blackleg in that district. A range of crops were sampled (Table 5) and 50 plants were taken randomly across the field (approximately 1 plant every 10 m travelled). These plants were cut at ground level and the amount of internal infection was scored per plant. The mean % internal infection was calculated for each paddock.

In previous years we have scored a variety (ATR-Beacon, BravoTT or Tawriffic TT) at the NVT trial at Lameroo to determine the level of infection with blackleg. The level has always been low (2, 5, 0% in 2004-2006 respectively). Very little evidence of blackleg has also been noted in more recent years.

The data presented in Table 5 show that we are now seeing a greater level of blackleg in the southern Mallee and that many of the crops are being sown to varieties that have a low level of blackleg resistance. The increase in blackleg can be attributed to a greater area being sown to canola in 2010 and 2011, as well as the summer and autumn rain in 2010-11 that resulted in a likely more rapid and greater release of blackleg spores throughout the district. With a further increase in area being cropped to canola in 2012 blackleg may begin to be an issue in the Mallee.

While the levels of internal infection are not as high as noted in the medium to high rainfall zone, if the amount of blackleg continues to increase, we should be looking to move to varieties with better resistance or consider limited use of fungicides in future.

3. New canola varieties that may be useful in the low rainfall zone

New canola varieties released in 2011

Blackleg ratings are those released in March 2011.

Conventional varieties

CB Agamax New Release 2011. Early-mid maturing hybrid. Canola Breeders indicate excellent yield in low to medium rainfall, excellent early vigour and good oil content. Blackleg resistance rating MR-MS (P). CB Agamax has not yielded as well as other conventional varieties when no fungicide was applied in 2010 trials. Tested in NVT trials in 2010 for the first time. Marketed by Canola Breeders.

Herbicide tolerant

Clearfield varieties

Hyola 575CL (tested as K9317). Mid-early season hybrid. Pacific Seeds indicate high grain yield and oil content about 1% more than Hyola 571CL. Medium plant height. Blackleg resistance rating MR (P). Tested in SA NVT trials in 2010 where it had higher grain yields than Hyola 571CL. Bred and marketed by Pacific Seeds.

44Y84 (CL) Early/early-mid season hybrid. Blackleg resistance rating MR-MS. Included in NVT trials in 2010. Similar grain yields to Hyola 571CL in 2010 trials. Bred and marketed by Pioneer Hi-Bred.

Triazine tolerant varieties

CB Junee HT™ (Trialled as CHYB-127). New Release 2011. Early maturing TT hybrid. Canola Breeders indicate excellent yield, good early vigour and good oil content. Blackleg resistance rating MS (P). Tested in NVT trials in 2010 for the first time. Bred and marketed by Canola Breeders.

Hyola 555TT (tested as T2522). Mid-early maturing TT Hybrid (TT version of Hyola 433). Pacific Seeds indicate excellent yield, excellent oil and high protein content. Ideally fits medium-low right through to high rainfall areas. This Hybrid exhibits good TT Hybrid vigour, medium plant height and excellent standability. Blackleg resistance rating MR (P). Tested in NVT trials in 2010. Bred and marketed by Pacific Seeds.

Hyola 444TT (tested as T98002). Early maturing TT Hybrid. Pacific Seeds indicate excellent yield, excellent oil and high protein content. Medium-short plant height. Ideally fits low to medium-high rainfall areas and exhibits good TT Hybrid vigour and good standability. Blackleg resistance rating MR-MS (P). Tested in NVT trials in 2010. Bred and marketed by Pacific Seeds.

Fighter TT (tested as T2181). Early to mid-early maturing double haploid OP TT variety. Pacific Seeds indicate good yield with moderate oil and very high protein content. Medium-short height. Ideally fits medium-low to medium-high rainfall areas, exhibits reasonable vigour and excellent standability. Blackleg resistance rating MR (P). First tested in NVT trials in 2010. Bred and marketed by Pacific Seeds.

ATR-Snapper (tested as NT0049). Early-mid maturing. Medium-short height. High oil and protein content. Blackleg resistance rating MS (P). Bred by Canola Alliance. Marketed by Nuseed Pty Ltd.

ATR-Stingray (tested as NT0045). Early maturing. Short height. High oil and protein content. Blackleg resistance rating MR-MS. Bred by AgSeed Research and DPI Victoria. Marketed by Nuseed Pty Ltd.

Likely new varieties for 2012

Clearfield varieties

Hyola® 474CL. Mid-early maturing CL Hybrid. Pacific Seeds indicate higher yield than Hyola 571CL, very high oil and high protein content. Medium-tall plant height. Ideally fits medium-low to high rainfall areas including irrigation, and exhibits excellent hybrid vigour. Anticipated high blackleg resistance rating R-MR. Tested in NVT trials in 2011. Bred and marketed by Pacific Seeds. New release for 2012.

43Y85CL (tested as 08N102I). Early maturing hybrid Clearfield canola. Pioneer Hi-Bred suggest it will be MR (P) for blackleg resistance and equivalent oil content to 44C79. Selected for short plant height and standability. Tested in NVT trials in 2011. Bred and marketed by Pioneer Hi-Bred.

Triazine tolerant varieties

Jackpot TT Mid-early maturing open pollinated TT variety. Pacific Seeds indicate very high yield, very high oil and very high protein content. Medium-short height. Ideally fits low to medium-high rainfall areas, exhibits good early vigour. Anticipated Blackleg resistance rating of MR. Bred and marketed by Pacific Seeds. Due to be released in 2012.

Bonanza TT Early maturing double haploid open pollinated TT variety. Pacific Seeds indicate good yield for maturity. Good oil and very high protein content. Short plant height suited for direct heading. Ideally fits low to medium rainfall areas, exhibits excellent early vigour similar to some TT Hybrids. Anticipated Blackleg resistance rating of MR. Currently being tested in NVT trials in 2011. Bred and marketed by Pacific Seeds. Due to be released in 2012.

ATR-Gem (tested as NT0107). Early-mid maturity triazine tolerant open pollinated variety with better blackleg resistance MR (P) and vigour than TawrifficTT. Slightly shorter than TawrifficTT and with slightly higher oil content. Bred and marketed by Nuseed. First year of NVT testing in 2011.

Acknowledgements

I thank Caroline Hilton, Matthew Hoskings, Jack Kay, Ian Ludwig and Robert Stacey for technical assistance. This project was funded in part by GRDC.