Brassica juncea in South Australia: where will it be grown and how does it fit into rotations?

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ABSTRACT

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. year^{-1}. 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*. These conditions are discussed in this paper and the growth and development of both *Brassica* crops is discussed based on trial data from low rainfall areas of eastern and western South Australia.

Key words: *Brassica juncea* – grain yield – area grown – low rainfall – harvest index

INTRODUCTION

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^{-1} 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.

MATERIALS AND METHODS

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.

RESULTS

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 0.317, 0.749 and 0.829 t.ha^{-1} 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 at 60 kgNha^{-1} 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 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 tha^{-1} for 44C79 and 0.71 tha^{-1} for OasisCL.

Table 1. Dry matter (g/m^2), measured at different growth stages and harvest index for canola (44C79) and *juncea* (OasisCL) at Lameroo in 2008-2010.

Year	Elongation DM		Flowering DM		Harvest DM		HI	
	44C79	OasisCL	44C79	OasisCL	44C79	OasisCL	44C79	OasisCL
2008	145	100	389	216	264	289	0.133	0.107
2009	124	119	363	201	377	430	0.263	0.245
2010	122	119	361	311	797	790	0.179	0.151

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).

Table 2. Grain yield ($t.ha^{-1}$) 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(0.05)	0.202	0.146	0.102

* TOS 1 = 3 May, TOS 2 = 27 May, and TOS 3 = 11 June.

Table 3. Grain yield ($t.ha^{-1}$) of canola and *juncea* at Minnipa in 2010.

Entry	TOS 1*	TOS 2*	TOS 3*
Canola			
44C79	1.46	1.58	1.29
Hyola50	1.62	1.70	1.58
Tarcoola	1.54	1.65	1.44
juncea			
OasisCL	1.13	1.05	0.84
SaharaCL	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(0.05)	0.097	0.069	0.121

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

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.

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	Total pulse	Total *Brassica*
	ha	ha	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

DISCUSSION

Brassica juncea has been shown to often produce higher grain yields than *B. napus* in lower rainfall conditions, especially when grain yields achieved have been less than 1.2 tha^{-1}. 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 tha^{-1} 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.

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.year^{-1} (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 be pulse or *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.

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