Comparing break crop performance in the SA Mallee

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Why was the trial was done?

Trials were implemented to compare break crop productivity and profitability on major soil types in the northern South Australian Mallee. This information will help farmers in this region to select the most appropriate break crop for their farming system.

How was the trial was done?

Trials were established at Waikerie and Loxton with two trials implemented at each site on contrasting soil types. At the Waikerie site, one trial was located on a sandy loam and the other on a shallow heavier soil with limestone while at Loxton trials were located on either a red loam or a deep sand. The break crops represented in the trial were field pea, vetch, chickpea, lentil, lupin and canola. In 2015, the Loxton site was sown on 28 April and the Waikerie site on 1 May.

Key Messages

- Break crops faced a range of tough environmental conditions in the Mallee in 2015 including multiple frost and heat shock events.
- Timely rainfall in April and hence early sowing resulted in excellent biomass production with most crop options producing on average more than 2 t DM/ha and several break crop options producing greater than 2.5 t DM/ha.
- The highest grain yields tended to be crops with the quickest maturity such as lentils (0.73 t/ha), vetch (0.64 t/ha) and field peas (0.63 t/ha).
- High value crops such as lentils and vetch were highly profitable due to both excellent prices and reasonable grain yields.
- Break crop productivity and profitability was very different between common Mallee soil types.

Background

Mallee farmers are looking to increase the proportion and diversity of broadleaved break crops in their paddock rotations, however very little localised information is available to support break crop selection and management in low rainfall environments. Furthermore, there is extreme soil type variability between Mallee paddocks, which adds additional complexity when selecting an appropriate break crop for these farming systems. To address these knowledge gaps, Mallee Sustainable Farming Inc, with funding from SAGIT, commenced a three-year project in 2015 to compare broadleaved break crop performance across four soil types in the northern Mallee of South Australia (SA). The aim of these trials is to provide farmers with information on the relative productivity of legume break crops in this low rainfall Mallee region.

About the trial

The trials are located at Waikerie and Loxton in the northern Mallee of SA with one trial located on each of two contrasting soil types within the same paddock. A brief description of each of the four trial sites is provided below:

- **Loxton Flat:** Red loam located in a swale
- **Loxton Sand:** Deep yellow sand located on the top of an east-west dune
- **Waikerie Flat:** Heavy red-grey soil with limestone from 20-30 cm below the surface
- **Waikerie Sand:** Red sandy loam located mid-slope

Each trial has nine different broadleaved crop options replicated four times. Table 1 shows the crop type, variety, target plant population and seeding rate used for each treatment. Each treatment at each site was managed independently to ensure that it had every opportunity to reach its potential. Agronomic management differences included herbicide choice, fertiliser rates and fungicide and pesticide applications.

The Loxton sites were sown on 28 April 2015 and the Waikerie site on 1 May 2015. All plots received 100 kg/ha of single super phosphate banded below the seed and all legumes were inoculated just prior to seeding with their specific Rhizobian strain using a peat inoculant.

All canola received an additional 100 kg/ha of urea applied immediately prior to sowing and incorporated by the sowing operation. Pre-emergence herbicide packages and rates were specific for each treatment and soil type. Grass weeds were controlled with an application of clethodim and haloxyfop on 26 June. Broadleaved weeds were controlled to an acceptable level by the knockdown and pre-emergence herbicide applications. Cowpea aphids at the Loxton trial sites were controlled by an application of omethoate on 9 July. Cabbage aphids and native budworm were controlled at all sites on 12 September using a mixture of pirimicarb and alpha-cypermethrin.

Crop performance was assessed by measuring establishment, peak crop biomass and grain yield. The trials were machine harvested across three dates from late-October to mid-November to ensure grain yield was measured soon after crops matured. Rainfall was recorded at both locations using automatic rain gauges and temperature was recorded at hourly intervals using iButton temperature loggers. One logger was placed at a height of 1.2 m above ground level (similar to official met gauges) and the other at 0.5 m to reflect crop canopy height.

Gross Margins were calculated for each treatment using the Rural Solutions Farm Gross Margin and Enterprise Planning Guide. The January grain prices from the 2016 guide were used to undertake the economic analysis (Table 1).

Table 1. *Break crop treatment details for Loxton and Waikerie trial sites*

Crop	Variety	Target plants per m²	Seeding rate (kg/ha)	Price ($/t)
Field Pea	PBA Wharton	45	90	550
Vetch	Rasina	60	40	850
Narrow-leaved Lupin	PBA Barlock	50	90	380
Albus Lupin	Luxor	35	120	380
Faba Bean	PBA Samira	20	140	560
Lentil	PBA Hurricane	120	50	1340
Desi Chickpea	PBA Striker	45	100	950
Kabuli Chickpea	Genesis 090	35	120	1050
Canola	Stingray	40	2.5	530

What happened?

Seasonal Conditions

Rainfall in 2015 was below average at both sites with 193 mm recorded at Loxton and 220 mm recorded at Waikerie from November 2014 to October 2015. Growing season rainfall was also below average with Loxton receiving 145 mm and Waikerie 133 mm. However, both sites received timely rainfall of approximately 40 mm in mid-April and a further 30-40 mm in the month of September.

Both trials were impacted by extremely low and high temperatures during the flowering and grain filling period (mid August – mid October) (Table 2). The coldest temperatures were recorded on 30 and 31 August when minimum temperatures were between -4 and -5°C at the Waikerie and Loxton flat sites respectively. There were fewer frost events at both sand sites due to their higher elevation within the paddock with minimum temperatures of -1 and -2.4°C recorded at the respective Waikerie and Loxton sites at the end of August. Both sites were also subject to a number of heat events during the flowering and grain fill period (Table 2) with three consecutive days of near or above 40°C at the beginning of October.

Table 2. *Number of days between 15 August and 15 October 2015 with a minimum temperature below 0°C or a maximum temperature above 30°C and 35°C at each trial site.*
Note: *Temperature loggers were placed at 50 cm from ground level to reflect crop canopy height.*

Site	Days<0°C	Days>30°C	Days>35°C
Loxton Flat	12	17	9
Loxton Sand	3	15	5
Waikerie Flat	9	16	8
Waikerie Sand	4	14	5

Biomass production

Field pea produced the greatest biomass with an average of 3.1 t DM/ha across all four trial sites and no less than 2.7 t DM/ha at any one (Table 3). Canola, vetch and lentil produced similar levels of biomass with 2.5 – 2.7 t DM/ha on average while desi chickpea, narrow leaved lupin and faba bean produced 2.1 – 2.3 t DM/ha across all sites. The lowest levels of biomass were produced by kabuli chickpea and albus lupins. Each crop produced its greatest biomass at the Loxton flat site with the exception of narrow leaf lupin and canola which performed best on the Loxton sand. The biomass produced by vetch was least on the Waikerie flat (<2.5 t DM/ha) than at the other three sites.

Table 3 *Peak biomass (t DM/ha) for each trial site and as an overall average across all sites*

Treatment	Loxton Flat	Loxton Sand	Waikerie Flat	Waikerie Sand	Overall
Albus Lupin	1.62	1.22	1.28	1.59	1.43
Kabuli Chickpea	2.17	1.30	1.48	1.58	1.63
Desi Chickpea	2.74	1.57	1.85	2.19	2.09
Narrow-leaved Lupin	2.56	265	1.97	1.71	2.22
Faba bean	3.01	2.09	2.20	1.94	2.31
Lentils	3.28	2.62	2.10	2.19	2.55
Vetch	3.41	2.97	1.80	2.55	2.68
Canola	2.49	2.96	2.94	2.40	2.70
Field Pea	3.57	3.30	2.67	3.00	3.14
p value	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
lsd (5%)	*0.54*	*0.63*	*0.46*	*0.42*	*0.50*

Grain Yield

Across all sites (Table 4), lentils had both the most consistent and the highest average grain yield (0.73 t/ha). Field peas only averaged 0.64 t/ha despite having the highest individual yield at any one site of 1.2 t/ha at the Waikerie sand. Field pea yields were particularly affected by frost on the Loxton and Waikerie flat sites. Vetch grain yields were also good with 0.63 t/ha while narrow leaf lupins, canola and faba bean yielded similarly at 0.5 – 0.53 t/ha. The later maturing crops, chickpeas and albus lupins, performed the worst in 2015 with average yields below 0.5 t/ha. Very low yields were obtained from these crops on the soils with the lowest water holding capacity at each site; Loxton sand and Waikerie flat.

Table 3 *Grain yield (kg/ha) for each trial site and as an overall average across all sites.*

Treatment	Loxton Flat	Loxton Sand	Waikerie Flat	Waikerie Sand	Overall
Albus Lupin	0.28	0.14	0.02	0.30	0.18
Kabuli Chickpea	0.43	0.22	0.05	0.45	0.29
Desi Chickpea	0.55	0.30	0.09	0.77	0.43
Narrow-leaved Lupin	0.71	0.60	0.20	0.49	0.50
Canola	0.52	0.69	0.20	0.66	0.52
Faba bean	0.83	0.55	0.29	0.46	0.53
Vetch	0.77	0.86	0.19	0.69	0.63
Field Pea	0.58	0.71	0.16	1.21	0.66
Lentils	0.96	0.64	0.48	0.82	0.72
p value	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*0.001*
lsd (5%)	*0.12*	*0.19*	*0.09*	*0.09*	*0.23*

Profitability

Lentils were the most profitable break crop option on all soil types in 2015, and averaged nearly $800/ha profit across all sites (Figure 1). This is a reflection of the extremely high price of $1340/t and high and constant yields across all sites relative to the other break crops. Vetch grain which also had a relatively high price was also a profitable option on all soils except the Waikerie flat. Field pea, faba bean and chickpeas returned $75 - $200/ha across all sites while canola and narrow leaf lupins usually broke even. Albus lupins was not a profitable option at any site.

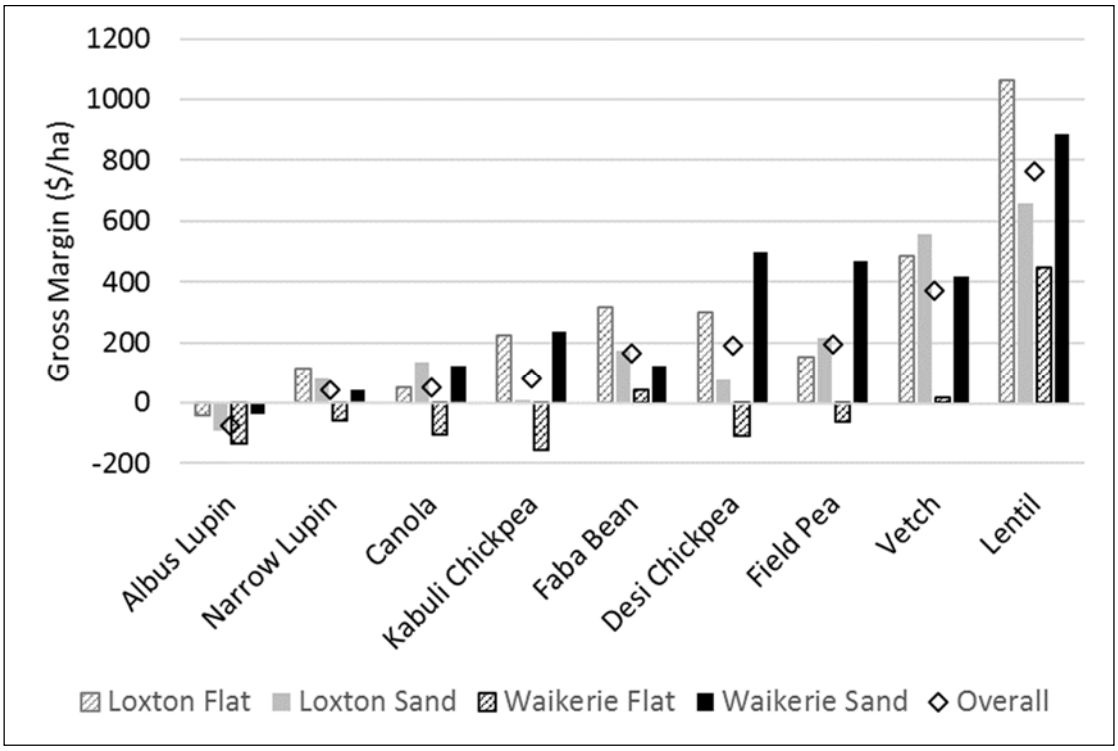

Figure 1 *Gross margin for each break crop at the four trial sites and for the overall average yield across all sites.*

What does this mean?

In 2015, break crops faced a range of tough environmental conditions in the Mallee, however some options still proved to be both productive and profitable. Timely rainfall in April and hence early sowing resulted in excellent biomass production with most crop options producing on average more than 2 t DM/ha and many break crop options producing greater than 2.5 t DM/ha. This is an important consideration where farmers are looking to increase nitrogen levels in their soil because every tonne of above ground legume dry matter is likely to result in 15-25 kg N/ha added to the soil (where legumes are well undulated). The highest grain yields tended to be crops with the quickest maturity such as lentils, vetch and field pea which handled the hot dry finish to the season better than later crops such as chickpea and lupins.

High value crops such as lentils and vetch were highly profitable due to excellent prices and reasonable average grain yields. A high grain price also helped both chickpea crops (desi and kabuli) to be profitable despite poor grain yields (although quality was not considered and may have been an issue at some sites). Field pea and chickpea have been the most profitable break crop options in recent trials in the Victorian Mallee where they were the highest yielding treatments in kinder seasons (Moodie *et al*., 2015).

These trials highlight significant variability in the productivity and profitability between the break crop options that may be considered by Mallee farmers. Furthermore, there was large variation in break crop productivity and profitability between the soil types commonly found in Mallee paddocks. Trials are continuing at all four sites in 2016 and 2017 to evaluate break crop performance across seasons and provide Mallee farmers with greater confidence when selecting break crops for inclusion in their farming system.

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