

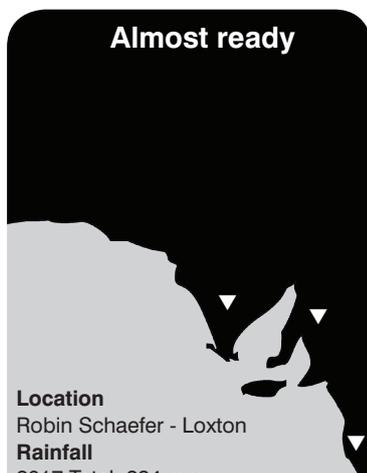
Identifying the most productive and profitable break crop options for low rainfall farming systems

RESEARCH

Michael Moodie¹, Todd McDonald¹, Nigel Wilhelm² and Ray Correll³

¹Moodie Agronomy, Mildura; ²SARDI, Waite Campus; ³Rho Environmetrics Pty Ltd, Adelaide

Almost ready



Location
Robin Schaefer - Loxton

Rainfall
2017 Total: 284 mm
2017 GSR: 135 mm
2016 Total: 426 mm
2016 GSR: 322 mm
2015 Total: 222 mm
2015 GSR: 174 mm

Paddock History
Cereal (Wheat/barley) prior to each break phase

Soil Type
Loxton Flat: Red loam
Loxton Sand: Deep yellow sand

Plot Size
15 m x 2 m x 4 reps

Yield Limiting Factors
2016: Frost
2015: Heat

Location
Brenton Kroehn - Waikerie

Rainfall
2017 Total: 237 mm
2017 GSR: 103 mm
2016 Total: 304 mm
2016 GSR: 208 mm
2015 Total: 198 mm
2015 GSR: 133 mm

Paddock History
Cereal (Wheat/barley) prior to each break phase

Soil Type
Waikerie Flat: Heavy red-grey soil with limestone from 20-30 cm below the surface
Waikerie Sand: Red sandy loam

Plot Size
15 m x 2 m x 4 reps

Yield Limiting Factors
2016: Frost
2015: Heat

Key messages

- The productivity of nine different break crop options across three seasons and four northern SA Mallee soil types was similar. Season and soil type had a greater impact on productivity than crop choice.
- Season had the greatest impact on break crop productivity with yields almost four times more in a high rainfall (decile 8-10) year than in a low (decile 2-4) rainfall season.
- Break crop yields varied by up to 60 percent between soil types. Production on the deep sand was constantly poor with lentil, chickpea and faba bean yields approximately half of what was achieved on a nearby loam soil.
- The potential for high value pulses to be used by Mallee farmers was demonstrated by these trials, with average lentil and chickpea gross margins of more than \$600/ha for the three seasons.
- The high yield and price variability demonstrated in these trials highlights the need for a diversity of break crops to be available for northern SA Mallee farming systems.

Why do the trial?

Farmers in the low rainfall zone are looking to increase the proportion and diversity of broadleaved break crops in their paddock rotations, however very little local information is available to support break crop

selection and management in these environments. Furthermore, there is often extreme soil type variability within 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 (productivity and profitability) across four major soil types in the northern Mallee of South Australia (SA).

How was it done?

Nine different broadleaved crop options were compared over three seasons (2015-2017) on four soil types commonly found in the northern Mallee region. Trials were located at Waikerie and Loxton and at each site trials were located on two contrasting soil types. A brief description of each of the four soil types 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

Table 1 shows the nine crop type and variety treatments used in each trial. Each trial was sown soon after the break of the season into moist soil to ensure successful inoculation. Trials were sown on the following dates in each season:

- 2015: Loxton, 28 April; Waikerie, 1 May
- 2016: Loxton, 26 May; Waikerie, 30 May
- 2017: Loxton, 5 May; Waikerie, 9 May

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. All trials were machine harvested across multiple dates in each season to ensure grain yield was measured soon after crops matured to minimise losses.

Gross margins were calculated for each treatment using the Rural Solutions Farm Gross Margin and Enterprise Planning Guide. Gross margins used the January grain price from the year following each trial (Table 1).

What happened?

Seasonal conditions

Figure 1 shows the annual rainfall received at Loxton and Waikerie for each of the three trial years. In 2015 and 2017, rainfall was generally below average with growing season rainfall (GSR)

at Loxton decile 5 and 3 and at Waikerie decile 3 and 2 for 2015 and 2017 respectively. Both seasons had good April rainfall allowing for timely sowing in early May. In 2016, both sites received exceptional GSR, especially in spring, with a decile 10 GSR recorded at Loxton and decile 8 GSR at Waikerie.

Frost affected sites in 2015 and 2017. A severe frost (-5°C) at the end of August in 2015 impacted yields on the lower lying 'flat' sites at Loxton and Waikerie and predominately affected the yields of field pea. Impacts on other crops was less obvious. In 2017 minimum temperatures of up to -3.4°C on the 28 and 30 August and then again on the 9 and 10 September visibly impacted field pea and lentil yields at all sites. No frost damage was observed in 2016 due to later sowing of the trials. In 2015, the trials were also subjected to severe heat stress with six days of above 40°C recorded in October.

Productivity

Field pea production, averaged over both soil types and all three seasons, was the best with an average yield of 1.3 t/ha while Albus lupins were consistently the worst yielding crop, producing an average yield of 0.6 t/ha (Table 2). All other break crop options averaged between 0.8-1.1 t/ha over all seasons and soil types.

There was a high level of variation in break crop yields both between

seasons and between soil types. For example, the average yield of all break crops in 2016 was nearly four times greater than in 2015 and 2017 (Table 2). The pattern of rainfall and temperatures within years was also important. In 2015, a hot and dry spring favoured crops with early maturity; field peas, vetch and lentils produced the highest average yield. In contrast frosts in August and September and significant rainfall in October favoured later maturity crops with chickpea and lupins producing the highest yields.

Break crops were most productive on the loamy soil of the Loxton flat site with all break crops averaging 1.3 t/ha for the three seasons. However, average break crop yields on the sandy soil at Loxton were only 60% of those achieved on the loam, despite the sites being located just 250 metres apart. Lentils, chickpea and faba bean performed particularly poorly on the sandy soil, producing 50% of the grain yield achieved on the better soil type. At Waikerie the best production was on the sandy loam soil (Waikerie sand) with an average yield of 1 t/ha across all crops and seasons. In comparison, the average yield at the Waikerie flat site was 0.8 t/ha. However, performance at this site was highly variable with seasonal conditions, being almost as productive as the Loxton and Waikerie sand sites in 2016 but extremely poor in 2015 and 2017.

Table 1. Broadleaved crop and varieties compared in each trial and prices used for gross margin analysis in each season.

Crop	Variety	2015 Price (\$/t)	2016 Price (\$/t)	2017 Price (\$/t)
Field pea	PBA Wharton	550	350	285
Vetch	Rasina	850	300	506
Narrow-leaved lupin	PBA Barlock	380	230	270
Albus lupin	Luxor	380	230	270
Faba bean	PBA Samira	560	270	315
Lentil	PBA Hurricane	1340	680	420
Desi chickpea	PBA Striker	950	1350	800
Kabuli chickpea	Genesis 090	1050	1450	900
Canola	Stingray	530	520	500

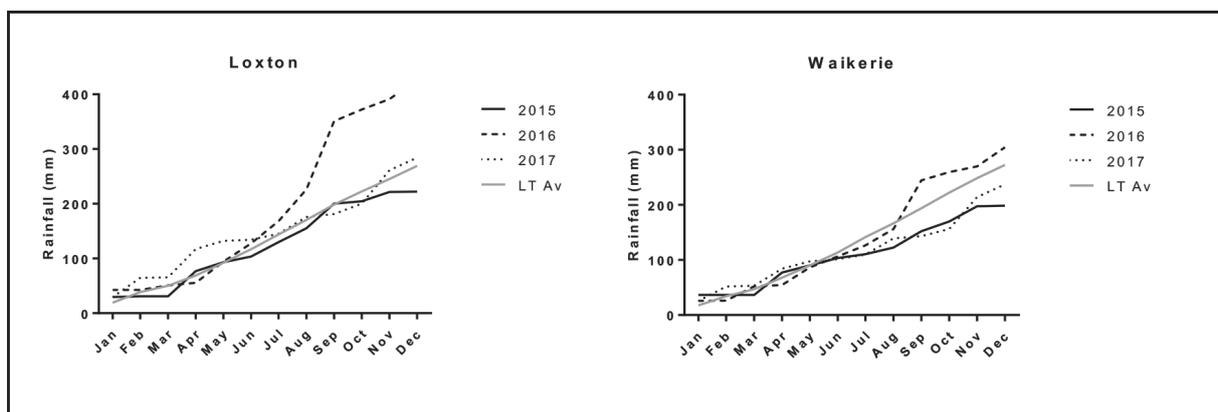


Figure 1. Cumulative annual rainfall for Loxton and Waikerie locations for the three trial years (2015-2017) and the long-term average (LT Av).

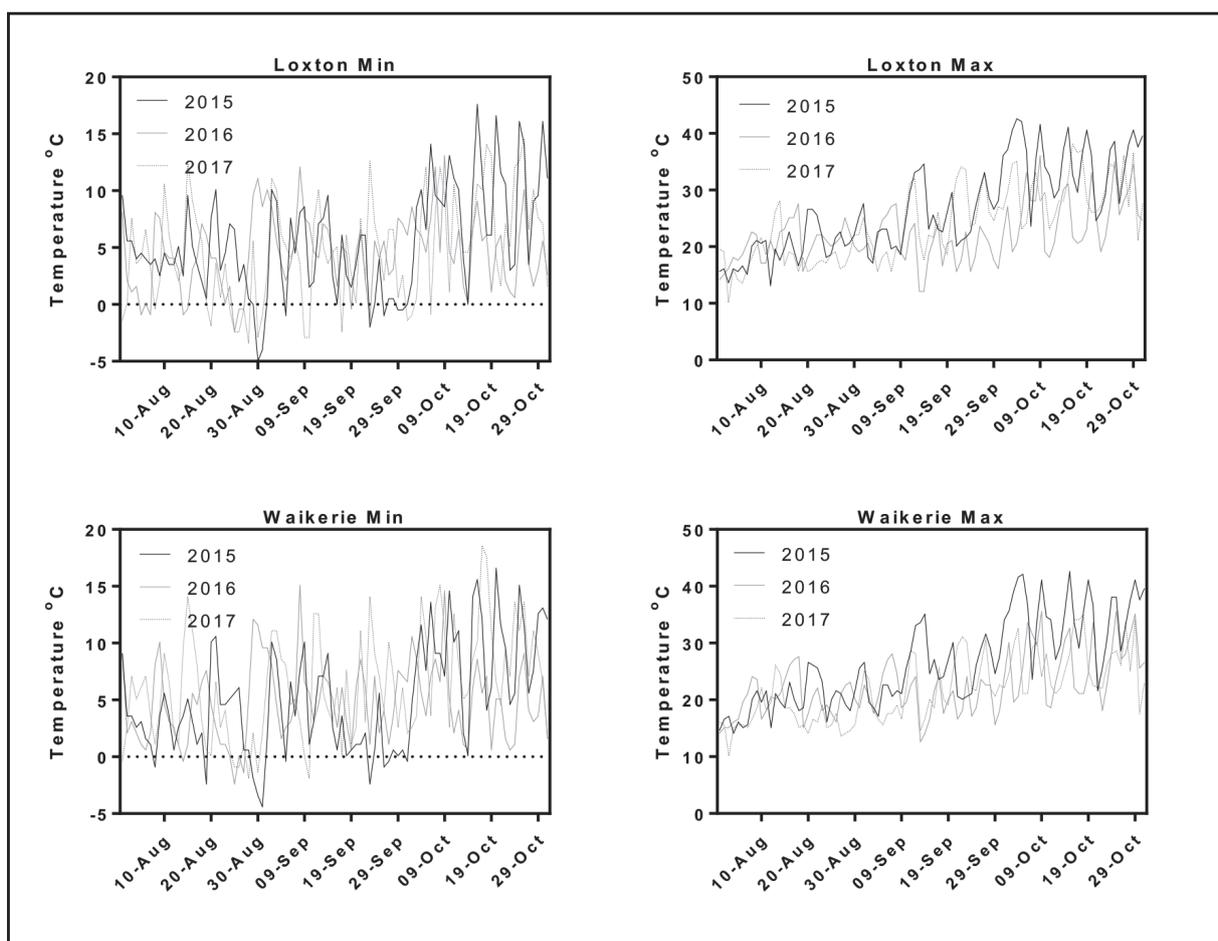


Figure 2. Daily minimum and maximum temperature measured at canopy height (50 cm) for August – October at the Loxton and Waikerie flat sites.

Profitability

The standout outcome from these trials was the high profitability of chickpea and lentils (Figure 3). Chickpeas (Desi and Kabuli) and lentils averaged more than \$600/ha across the three seasons with these options averaging \$1000-2000/ha in 2016 when high yield and prices coincided.

Vetch, field pea and canola also produced good gross margins over the three trial years with gross margins of \$300, \$250 and

\$200/ha respectively. Field pea had the most variable profitability of all crops, ranging from \$700/ha in 2016 to -\$50/ha the following season.

The profitability of narrow leaf lupin and faba beans was moderate, averaging approximately \$100/ha. Despite producing nearly twice as much grain as lentils and chickpea on the Loxton sand, the overall profitability of lupins was only half of these crops at this site.

The benefit of high value crops was also evident in the lower rainfall seasons. In 2015, lentils produced a gross margin of over \$700/ha despite moderate yields (0.7 t/ha across all sites), because their price was \$1340/t at the time. However, lentils only just broke even in 2017 when their price had dropped from 2015 levels by nearly \$1000/t.

Table 2. Break crop grain yields (t/ha) on four northern SA Mallee soil types for three seasons (2015-2017).

Year	Site	Albus lupin	Kabuli chickpea	Canola	Desi chickpea	Faba bean	Lentils	Narrow lupin	Vetch	Field pea
2015	Loxton Flat	0.3	0.4	0.5	0.5	0.8	1.0	0.7	0.8	0.6
	Loxton Sand	0.1	0.2	0.7	0.3	0.6	0.6	0.6	0.9	0.7
	Waikerie Flat	0.0	0.1	0.2	0.1	0.3	0.5	0.2	0.2	0.2
	Waikerie Sand	0.3	0.4	0.7	0.8	0.5	0.8	0.5	0.7	1.2
	Average (all sites)	0.2	0.3	0.5	0.4	0.5	0.7	0.5	0.6	0.7
2016	Loxton Flat	2.0	1.6	1.6	2.1	2.9	3.1	2.9	2.8	3.0
	Loxton Sand	0.6	0.6	1.0	0.9	1.5	0.9	2.1	2.0	1.7
	Waikerie Flat	1.0	1.2	1.5	1.6	1.6	2.5	1.8	1.8	3.6
	Waikerie Sand	1.0	2.5	1.6	2.4	1.7	1.9	1.5	2.2	3.2
	Average (all sites)	1.2	1.5	1.4	1.8	1.9	2.1	2.1	2.2	2.9
2017	Loxton Flat	0.7	1.0	0.7	1.0	0.9	0.9	1.3	0.8	0.7
	Loxton Sand	0.5	0.4	0.5	0.4	0.2	0.3	1.2	0.7	0.4
	Waikerie Flat	0.1	0.4	0.4	0.3	0.4	0.3	0.3	0.3	0.3
	Waikerie Sand	0.1	0.5	0.5	0.5	0.1	0.2	0.5	0.5	0.6
	Average (all sites)	0.4	0.6	0.5	0.5	0.4	0.4	0.8	0.6	0.5
Average (all years)		0.6	0.8	0.8	0.9	1.0	1.1	1.1	1.1	1.3

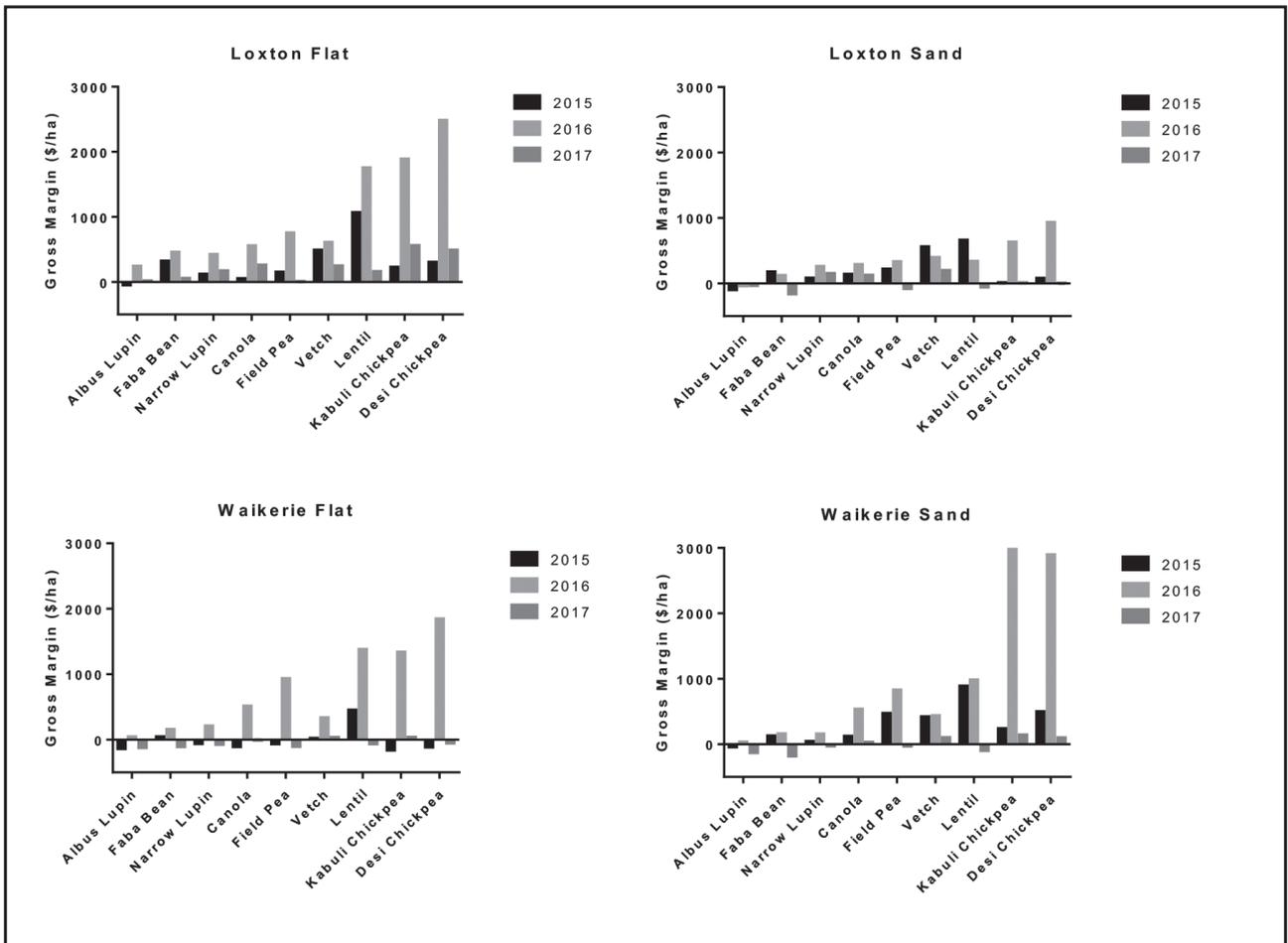


Figure 3. Break crop gross margins on four northern SA Mallee soil types for three seasons (2015-2017).

An interesting outcome of the analysis was that there was much greater potential for upside profit than downside risk. For example, all crops with the exception of the poorly adapted Albus lupins at least broke even in 2015 and 2016 at the Loxton flat and sand sites and at the Waikerie sand site. In 2017, negative gross margins were more common, however these losses tended to be relatively small, especially in comparison to the profits achieved by these crops in the previous season. The Waikerie flat site, which has a shallow soil, proved to be the most 'risky' site with most crops producing negative gross margins in both of the drier seasons (2015 and 2017), however profitability was similar to other sites with a favourable season (2016).

Profitability varied by more than 50% between soil types. On the Loxton flat, the average gross margin across all crops for the three seasons was \$500/ha which was 60% more than the gross margin of crops on the sandy soil. At Waikerie, the average gross margin of all crops on the sandy loam soil was \$450/ha, which was 50% greater than the profitability of crops grown on the flat. Break crop profitability was highly variable on the flat with large gross margins produced by canola, field

pea, lentil and chickpea in the favourable 2016 season, however only lentils in 2015 produced a gross margin greater than \$50/ha in the lower two rainfall years.

What does this mean?

This project highlights that a high level of diversity is desirable when integrating break crops into Northern SA Mallee farming systems. Overall, most break crops had similar productivity potential, however the yields achieved in any one season were highly influenced by seasonal conditions (e.g. amount and distribution of seasonal rainfall, frost and heat events) and soil type.

In these trials, price had a greater influence on the profitability of the break crops than productivity. High prices received for lentils and chickpeas during the past three years resulted in some exceptionally high gross margins for these crops which demonstrated that high value crops have a fit in the low rainfall Mallee farming systems. However, farmers need to be mindful of the volatility of pulse crop markets, as demonstrated by lentils, whose price fluctuated by nearly \$1000/ha over the duration of the trials. This exposure to price risk further confirms the need to grow a number of break crops in low rainfall farming systems.

Acknowledgements

South Australian Grain Industry Trust (SAGIT) for providing funding for this project. Matt Whitney (Dodgshun Medlin) for providing advice on trial management. Todd McDonald (MSF) and Peter Telfer (SARDI) for their technical assistance on the trial. Brenton Kroehn and the Lowbank Ag Bureau for assistance in selecting and setting up the Waikerie site and Bulla Burra staff for assistance at the Loxton site.

