



Office Use Only

Project Code	
Project Type	

FINAL REPORT 2021

Applicants must read the *SAGIT Project Funding Guidelines 2021* prior to completing this form. These guidelines can be downloaded from www.sagit.com.au

Final reports must be emailed to admin@sagit.com.au as a Microsoft Word document in the format shown **within 2 months** after the completion of the Project Term.

PROJECT CODE	:	MPF118
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PROJECT TITLE	(10 words maximum)
Profitable Pulses for the Murray Plains	

PROJECT DURATION

*These dates **must** be the same as those stated in the Funding Agreement*

Project Start date	1 July 2018
Project End date	30 June 2021

PROJECT SUPERVISOR CONTACT DETAILS

The project supervisor is the person responsible for the overall project

Title:	First Name:	Surname:
	Michael	Moodie
Organisation:		
Frontier Farming Systems		

PROJECT REPORT

Provide clear description of the following:

Executive Summary (200 words maximum)

A few paragraphs covering what was discovered, written in a manner that is easily understood and relevant to SA growers. A number of key dot points should be included which can be used in SAGIT communication programs

Analysis through this SAGIT-funded trial assessing the productivity, sustainability and profitability of break crop options for the Murray Plains, along with associated agronomic requirements, demonstrated the following:

- Lentils are likely to be both the most profitable and least risky pulse crop grown in the long term. Analysis showed the average long term gross margin for lentils is predicted to be \$365/ha and, importantly, a negative gross margin is expected only 15% of the time. Lentils have the strong possibility of achieving a high gross margin with a gross margin of more than \$500/ha probable 28% of the time.
- Vetch was the next most profitable break crop in the trial with an average gross margin of \$255/ha, however as the grain is predominantly sold for seed to plant fodder and hay crops so the market is limited and becomes easily flooded.
- Chickpea and field pea had similar profitability and risk outcomes with both having a mean long-term gross margin of about \$200/ha. Both crops had similar risk of not achieving a break-even gross margin (25%) while both crops had an 15% probability of the gross margin exceeding \$500/ha.
- Lupin and faba bean had lowest simulated long-term gross margins of \$65/ha. Faba bean were also the riskiest crop and expected to not break even in 49% of seasons. Lupin has the lowest probability of achieving a high gross margin of more than \$500/ha. This is due to low long term price outcomes for lupins relative to other pulse crops.

Project Objectives

A concise statement of the aims of the project in outcome terms should be provided.

Chickpeas and lentils have traditionally not been grown in the Murray Plains area and yet they are valuable and profitable break crops in many other parts of SA. More commonly grown break crops in the area are vetch and peas because of the grazing option and their suitability for heavy soils respectively. However, making these a profitable contributor to the rotation has long been a challenge for Murray Plains growers.

This SAGIT-funded project has enabled Murray Plains grain growers to be able to:

- Select appropriate break crops that enhance the productivity and sustainability of their crop sequences.
- Increase their understanding about the agronomic requirements to successfully grow legumes in the area.
- Ensure pulses are a profitable contributor to rotations and the farm business overall.

Overall Performance

A concise statement indicating the extent to which the Project objectives were achieved, a list of personnel who participated in the Research Project including co-operators, and any difficulties encountered and the reasons for these difficulties.

Objective 1: Select appropriate break crops that enhance the productivity and sustainability of their crop sequences.

- A range of break crop options were trialled in 2018, 2019 and 2020 and productivity of each assessed according to a range of agronomic factors. In 2018 at Sedan, leading commercial varieties of canola, chickpea, field pea, lentil and vetch were grown, along with an unreplicated faba bean demonstration. Lupins were not included due to soil type at the trial site. In 2019 at Angas Valley, five replicated trials evaluating the leading commercial varieties of canola, chickpea, field pea, vetch, lentils and lupins were established, along with the demonstration faba bean trial. In 2020 at Palmer, replicated trials were established for two sowing times for canola, chickpea, field pea, lentil, vetch, faba bean and lupin.

Objective 2: Increase their understanding about the agronomic requirements to successfully grow legumes in the area.

- A range of agronomic practices were explored in addition to the replicated trials of pulse varieties. In 2018, a field pea blackspot management trial was established at the site comparing numerous fungicide products as well as a replicated pre-emergent herbicide demonstration trial. In 2019, a vetch management trial investigated the effect of gibberellic acid and the timing and application of dry matter production as well as second management trial to compare inoculation products. In 2020, a pasture demonstration trial was included (these results are included later in this report).

Objective 3: Ensure pulses are a profitable contributor to rotations and the farm business overall.

- Profitability analysis was conducted on each break crop option in every year of the trial. Results from 2020 were most valuable and are included in this report. Results from 2018 and 2019 results were significantly drought affected and have been included in previous progress reports.

List of research personnel

This project was based on a similar project run by Mallee Sustainable Farming in its region a few years prior. This trial was operated by Michael Moodie, Frontier Farming Systems, hence seeking his involvement as project supervisor for this trial in the Murray Plains.

Due to Michael's involvement, the following people were involved in the trial over the three years:

- Frontier Farming Systems research team – Charlton Jeisman, Chris Davies, Declan Anderson
- Peer review – Kenton Porker, SARDI.
- Trial hosts – Greg Schultz at Sedan, McGormans' Thornby at Angas Valley, Steen and Deanna Paech, Hillydale Farms, at Palmer.

Difficulties encountered

Drought - The final year of trials was completed in 2020. Similar trials were conducted near Sedan in 2018 and Angus Valley in 2019, however both sites were severely drought affected with both trials coinciding with the worst rainfall years on record for the region. Due to this, data generated was not as robust as it could have been. As the data set was skewed towards severely drought years, we have combined the results from this project with data from trials conducted on similar soil types and climates (e.g. Northern SA, Vic and NSW Mallee) to undertake a longer term analysis of break crop profitability.

Site selection was also made difficult by the drought conditions during the life of the project. Due to the low rainfall, there were plantback issues with chemical use between years and appropriate site selection became more difficult.

COVID - The onset of COVID-19 early in 2020 made travel into SA difficult for a Victorian-based business. To ensure that this did not impact the result of the trials, Frontier Farming Systems engaged other service providers to ensure trial management was not compromised. These operators were EP Ag, Grains Innovation Australia (GIA) and SARDI. Michael was also not able to participate in site visits as he had done in previous years. In lieu of his attendance, Michael organised Larn McMurray (GIA) and Ross Ballard and David Peck to talk about the various crops and varieties at the sites September field walk.

Key Performance Indicators (KPI)

*Please indicate whether KPI's were achieved. The KPI's **must** be the same as those stated in the Application for Funding and a brief explanation provided as to how they were achieved or why they were not achieved.*

KPI	Achieved (Y/N)	If not achieved, please state reason.
2018 – sign contract and complete trial design with MPF Committee	Y	
2018 – Member comms update on new trial	Y	
2018 – Year 1 trials sown	Y	
2018 – Benchmark evaluation completed	Y	
2018 – Spring crop walk completed	Y	
2019 – Year 1 findings presented at MPF Post-Harvest Seminar	Y	
2019 – Member comms update on results and trial for year ahead	Y	
2019 – Year 2 trials sown	Y	
2019 – Spring Crop Walk completed	Y	
2020 – Year 2 findings presented at MPF Post-Harvest Seminar	Y	
2020 – Member comms update on results and trial for year ahead	Y	
2020 – Year 3 trials sown	Y	
2020 – Spring Crop Walk completed	Y	

2021 – Final findings presented at MPF Post-Harvest Seminar	Y	
2021 – Member comms update on final results	Y	
2021 – Final Report and evaluation	Y	

Technical Information (Not to exceed **three** pages)
Provide sufficient data and short clear statements of outcomes.

YEAR 3: 2020

Key messages from the 2020 trial

- Average growing season rainfall with an early break lead to grain yields of between 0.9-1.6t/ha for the leading variety within each break crop.
- Later sowing generally benefited pulse crops while early sowing favoured canola in 2020.
- Variety selection was important in field pea, chickpea and vetch however variety choice did not influence the yield of lentil, lupin, faba bean and vetch.
- The most profitable break crops in 2020 were canola, vetch and lentil which all produced high gross margins of approximately \$600/ha.
- Long term profit and risk analysis of pulse crops shows that lentils are likely to have not only the best long term gross margin, but also will have the least number of seasons with negative gross margins.

About the 2020 trial

Replicated trials were established for two sowing times for Canola, Chickpea, Field Pea, Lentil, Vetch, Faba bean and Lupin. Each trial comprised of four leading varieties sown in four replicates (Table 1).

Table 1. Details of break crops variety evaluation trials in 2020.

Canola	Chickpea	Field pea	Lentil	Vetch	Faba bean	Lupin
ATR Stingray Nuseed Diamond Pioneer 44T02 TT HyTTec Trident	Genesis 090 PBA Royal PBA Striker CBA Captain	PBA Wharton PBA Twilight PBA Gunya PBA Butler	PBA Jumbo2 PBA Hurricane PBA Highland PBA Hallmark	Studenica Volga Timok Morava	PBA Marne PBA Samira PBA Bendoc 1225	Coyote PBA Jurien PBA Bateman Mandelup

Time of sowing 1 (TOS1) trials were sown on 7 May and the second sowing time (TOS2) was 26 May. All trials were sown with 50kg/ha of Granulock Z and both canola trials received a further 150kg/ha of urea which was spread before sowing and incorporated by the sowing process. Weeds were controlled with a knockdown application of glyphosate prior to cropping with in-crop grass weeds controlled with clethodim and haloxyfop. Broadleaf weeds were managed with pre-emergent herbicides specific to each crop. Insects were controlled with Trojan insecticide during spring. All trials were harvested with a mechanical plot harvester.

Gross Margins were calculated for each crop type using the yield of the best performing treatment for each TOS for the variety trials. Gross margins were calculated using the Rural

Solutions Farm Gross Margin and Enterprise Planning Guide. Gross margins used the January grain price which was supplied by Grainwise.

Results & Discussion

Rainfall and Climate

Total rainfall for the year at the site was below average with 262mm, however most of this rainfall fell within the growing season (222mm). An early sowing opportunity was facilitated by 60mm falling in April-May, while a further 60mm of rainfall during September and October and provided favourable conditions during the critical flowering and pod fill stage. The period from July – August was well below average and moisture stress was evident throughout the district. It is also worth noting the two severe frost events that occurred in early August which may also have had an impact on pulses sown at TOS 1.

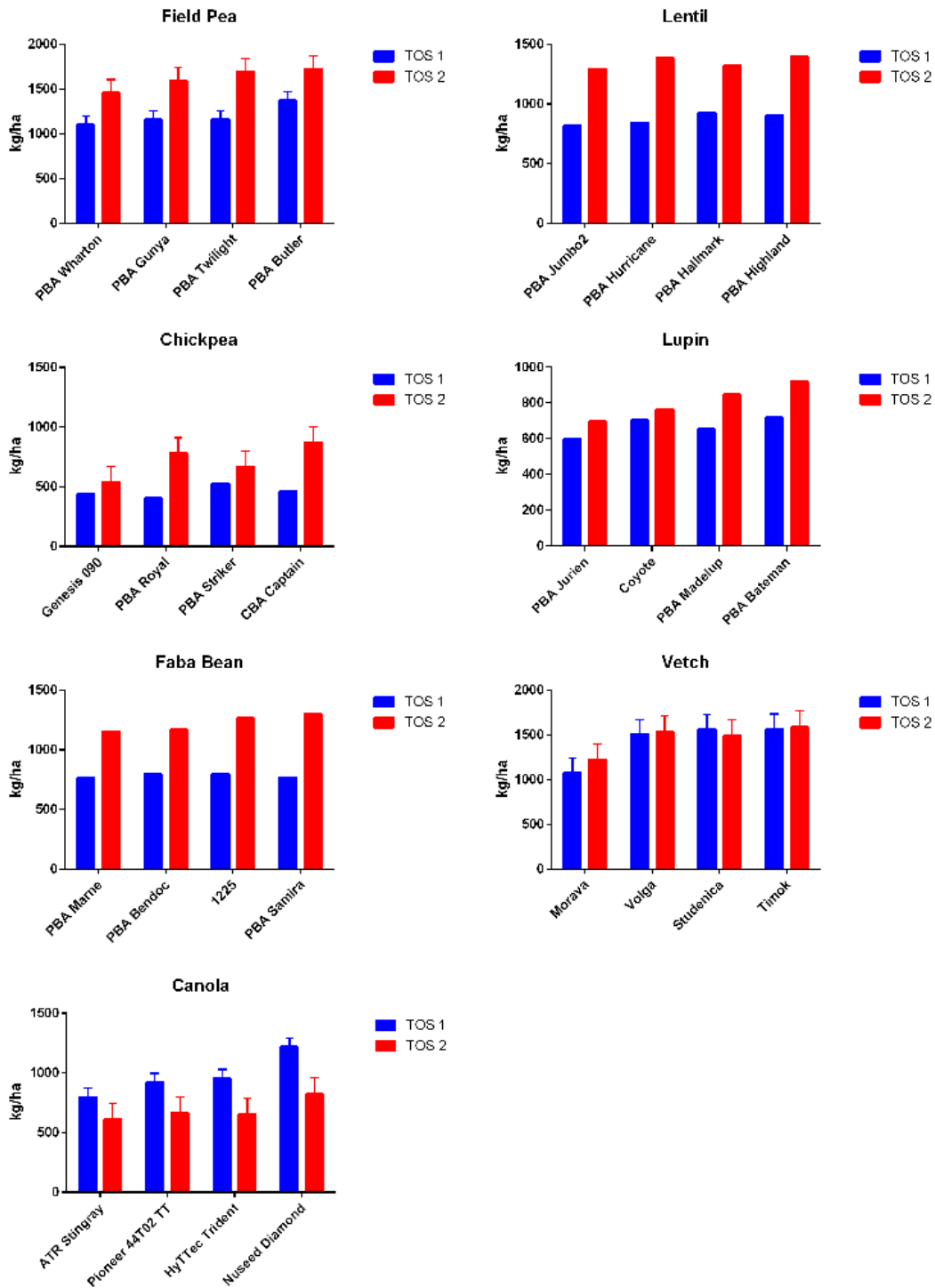
Time of sowing

Sowing time cannot be statistically compared as each time of sowing were managed as separate blocks. However, the general trend was for the grain yield of pulse crops to be favoured by delayed sowing in 2020 (Figure 1). The average yield of the TOS 2 trials was higher than the yield of TOS 1 trials by 0.5t/ha for lentil, 0.4 t/ha for field pea and faba bean and 0.25t/ha for chickpea. In contrast the average canola yield for TOS 1 was 0.3t/ha higher than the average canola yield in the TOS 2 trial. The average yield of vetch and lupin was similar between both the TOS 1 and TOS 2 trials

Productivity

There were significant differences between varieties for field pea, chickpea, lupin, vetch and canola (Figure 1). Lentil and faba bean yields did not differ between the four varieties in the experiment (Figure 2). A summary of the significant differences is provided below:

- Variety performance changed with sowing date
- PBA Butler yielded significantly more at TOS 1 than the other three varieties. At the second sowing time, PBA Butler and PBA Twilight yielded similar and significantly greater than PBA Wharton.
- CBA Captain and PBA Royal had significantly higher grain yields than Genesis 090 when sown at the second sowing time but cultivars were similar at the first sowing date.
- Morava had the lowest grain yield of all vetch varieties at both sowing times and all other varieties were similar.
- September biomass was also measured for vetch to simulate a hay cut scenario. Volga vetch sown at TOS 1 produced significantly more biomass than the other varieties sown at the same time with 3.2t/ha compared to 2.6t/ha. There was no difference in biomass production between varieties sown at TOS 2 with an average of 2.6t/ha across all varieties.
- The Canola variety Nuseed Diamond had significantly higher yields than the other varieties in both the TOS 1 and TOS 2 trials. Both hybrid TT varieties Pioneer 44T01 and HyTTec Trident yielded similarly across both sowing dates. These two varieties had significantly higher yields than ATR Stingray at TOS 1 but yields were similar to ATR Stingray at TOS 2.



Caption: Grain yield for the four varieties grown for each break crop. Each time of sowing (TOS) was a separate trial and therefore varieties can only be statistically compared within each TOS. Error bars represent the LSD for each TOS trial. Bars without an LSD indicate no significant yield differences between varieties in the trial.

Profitability

Gross margin analysis showed that each of the break crop options trialed in 2020 had a positive gross margin (Table 2). The most profitable crops were canola, vetch and lentils based on 2020

yields and grain prices. The gross margin for each of these crops was approximately \$700/ha. The next most profitable crops were field pea with around \$300/ha and chickpea \$250/ha. The gross margins for both lupin and faba beans were \$180/ha. This is the first year of the project where gross margins have been positive. In 2018, field pea, canola and vetch produced break even gross margins, while in 2019 only lentils (\$30/ha) had a positive gross margin.

Table 2. *Gross margins of the best yielding variety for each break crop variety trial.*

Crop	Variety	Grain yield (t/ha)	January 2020 price (\$/t)	Gross Margin (\$/ha)
Canola	Nuseed Diamond (TOS1)	1.2	571	729
Vetch	Timok (TOS 2)	1.6	600	729
Lentil	PBA Highland (TOS 2)	1.4	672	686
Field Pea	PBA Butler (TOS 2)	1.7	350	319
Chickpea	CBA Captain (TOS 2)	0.9	610	256
Lupin	PBA Bateman (TOS 2)	0.9	393	184
Faba Bean	PBA Samira (TOS 2)	1.3	370	180

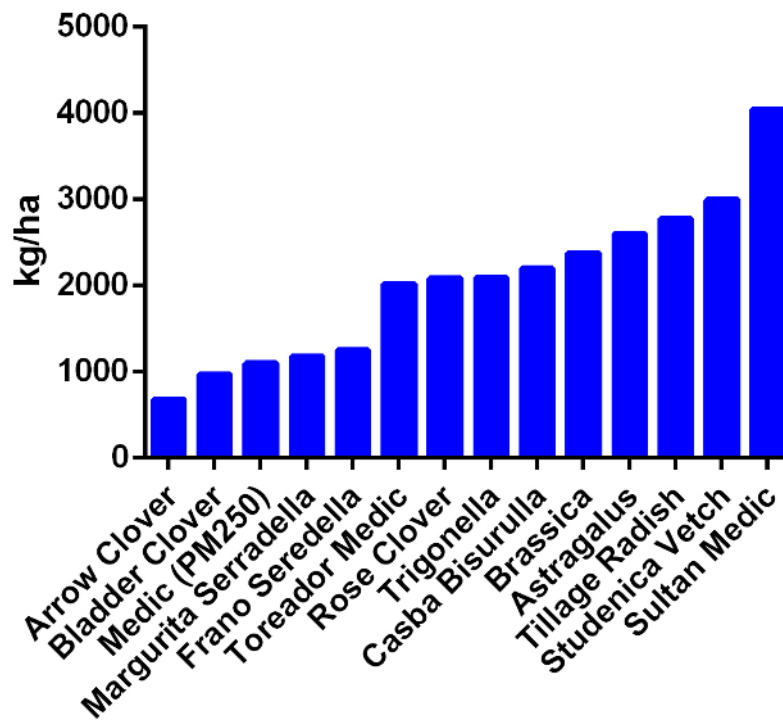
Pasture demonstration trial

In 2020, Michael Moodie included a small pasture demonstration trial with various varieties of vetch, clover, medic and other species (see image next page). MPF invited SARDI researchers Ross Ballard, David Peck and Stuart Nagel to attend the 2020 Crop Walk and share their knowledge about upcoming vetch varieties as well as insights from the Dryland Legume Pasture Systems (DLPS) trial at Lameroo. This information was very well received by the group and the different species displayed generated lots of interest from attendees.



In terms of results, the pasture trials were set up as demonstrations and not replicated. Data presented included final biomass (see graph below). Frontier Farming Systems took large samples and two quadrates from each plot in the September sampling.

September Biomass



YEAR 2: 2019

Key Messages

- Low growing season rainfall restricted the yields of all break crops at Angas Valley in 2019.
- The best chickpea, field pea, lentil and faba bean varieties produced grain yields of 0.3-0.4t/ha.
- Lentils were the most profitable break crop option with PBA Hallmark producing a small positive gross margin.
- Applying gibberellic acid to vetch did not affect overall production or canopy height.
- Inoculating chickpea has a positive effect on nodulation but this did not result in yield benefits in 2019.

About the trial

Six replicated trials and two demonstration trials were implemented in the Murray Plains district in 2019 near Angas Valley. The trials were developed through consultation with Murray Plains farmers and with input from leading industry experts. Five replicated trials evaluating the leading commercial varieties of canola, chickpea, field pea, lentils and lupin were implemented along with an un-replicated faba bean demonstration (Table 1a).

Table 2a. Details of break crops variety evaluation trials in 2019.

Canola	Chickpea	Field pea	Lentil	Vetch	Faba bean (demo only)	Lupin
ATR Stingray Nuseed Diamond ATR Bonito Pioneer 44Y90 HyTTec Trophy HyTTec Trident Pioneer 43Y92	<i>Kabuli type:</i> Genesis 090 PBA Monarch PBA Kalkee CICA1156 CICA 1352 <i>Desi Type:</i> PBA Slasher PBA Striker CICA1521	PBA Oura PBA Butler PBA Percy PBA Wharton PBA Twilight PBA Pearl PBA Gunya	PBA Bolt PBA Hurricane PBA Jumbo2 PBA Ace PBA Hallmark PBA Greenfield CIPAL 1621	Morava Timok Volga Studenica	PBA Samira PBA Marne (demo only)	PBA Barlock PBA Jurien PBA Bateman Mandelup

A vetch management trial was also established at the site to investigate the effect of gibberellic acid and the timing of application of dry matter production. ProGibb®SG was applied at 20g/ha either at seeding, early winter or late winter. There were four varieties of vetch included in the trial: Studenica, Volga, Timok and Morava. Dry matter was measured on 20 September 2019 when vetch varieties were in early pod development.

A second management trial was established to compare inoculation products. Chickpea (Genesis 090) was sown without inoculant, with a peat slurry (BASF Nodulator) or peat granule (TagTeam Granular). Both the slurry and granular inoculants were applied at the recommended and twice recommended rates. Peat slurry was also applied as an in-furrow liquid stream. All inoculation products were group N which is specific to chickpea.

All trials were sown on the 23 May 2019. All trials were sown with 50kg/ha of Granulock Z. Weeds were controlled with a knockdown application of glyphosate prior to cropping with in-crop grass weeds controlled with clethodim and haloxyfop. Broadleaf weeds were managed with pre-emergent herbicides specific to each crop (Table 1a). Insects were controlled with Trojan insecticide during spring. All trials were harvested on 18 November 2019.

Gross Margins were calculated for each crop type using the yield of the best performing treatment from the six variety trials. Gross margins were calculated using the Rural Solutions Farm Gross Margin and Enterprise Planning Guide. Gross margins used the January grain price from the year following each trial (2020).

Results & Discussion

Seasonal conditions were very challenging in 2019 with approximately 90mm of growing season rainfall recorded at the site. Furthermore, rainfall events were often small and infrequent and, as a result, productivity of the break crops was low.

Chickpea Varieties

Chickpea yields were very low and there was no significance between varieties. The overall yield across all varieties was 260kg/ha. There were significant differences in grain size with desi types (PBA Striker, PBA Slasher and CICA1521) having significantly smaller grain the Kabuli types. Of the Kabuli varieties, CICA1352 had the largest grain sizer and Genisis090 the smallest. Kalkee, PBA Monarch and CICA1156 all produced similar size grain.

Field Pea Varieties

The highest yielding varieties were PBA Percy and PBA Pearl which both yielded significantly higher than the other treatments. All other varieties yielded less than 300kg/ha. Interestingly PBA Twilight was the lowest yielding variety but was the highest yielding treatment in 2018. When the site was visited on 20 September 2019, a significant amount of frost damage was visible, and therefore this may have affected the true yield potential.

Lentil Varieties

The highest yields were from Hallmark (391kg/ha), Hurricane (359kg/ha) and CIPAL 1621 (352kg/ha). There was no statistically significant difference between those varieties.

Canola and Lupins

Both canola and lupin failed to establish adequity and did not produce a harvestable yield. Both crops were sown much shallower than the other crops at the site due to their epigeal emergence. This requirement for shallow sowing is often a constraint on sandy soils in seasons with marginal soil moisture, as the seedbed can dry out very quickly resulting in poor emergence.

Vetch gibberellic acid management trial.

There were significant differences in dry matter production ($p < 0.001$) between varieties with the highest yield of 1691kg/ha for Volga and 1613kg/ha for Studenica (Table 2a). There were no effects of gibberellin treatments on plant density, plant height or dry matter (Table 3a). This is despite early visual differences soon after gibberellic treatments were applied.

Table 2a. Effects of vetch variety on crop establishment, plant height and dry matter production.

Measure	Morava	Studenica	Timok	Volga	p value	LSD
Plants m ²	34.4	36.9	35.2	39.1	0.054	NA
Plant height (cm)	24.1	22.8	25.0	23.1	0.090	NA
Dry matter (kg/ha)	1355	1613	1512	1691	<.001	137

Table 3a. Effects of gibberellin treatments on crop establishment, plant height and dry matter production.

Measure	Nil	Seeding	Early	Late	p value	LSD
Plants m ²	37.6	32.9	37.8	37.3	0.308	NA
Plant height (cm)	24.7	26.6	24.4	19.4	0.364	NA
Dry matter (kg/ha)	1541	1688	1450	1492	0.143	NA

Inoculation management trial

There were highly significant effects of the treatments on the number of nodules and on the total weight of nodules per plants. However, the treatments had little or no effect on shoot or root weight and this was reflected in there being no significant effect on grain yield. The absence of yield difference is likely due to the low yield and therefore nitrogen demand of the crop, with soil nitrogen supply enough to meet the requirements of the uninoculated plants.

Uninoculated plants had very few nodules while the highest nodule numbers were in the Tag Team granular treatment, especially at the high rate. The seed applied peat slurry treatments had higher nodule numbers than the liquid application, but the difference was not statistically significant. Despite tending to have fewer nodules than the granular treatments, slurry inoculation produced large sized nodules and therefore both the Nodulator peat and Tag Team granular products produced similar nodule weight per root mass.

Profitability

Lentils produced the highest gross margin of the grain legume crops making a small profit of \$32/ha (Table 4a). All other grain legume treatments produced negative gross margins. Chickpea, field pea and faba bean resulted in a loss of \$50-\$100/ha. No canola or lupin varieties

Table 4a. Gross margins of the best yielding variety for each break crop variety trial.

Crop	Variety	Grain yield (t/ha)	January 2019 Price (\$/t)	Gross Margin (\$/ha)
Canola	-	Nil	600	-
Chickpea	PBA Striker	0.29	590	-65
Field Pea	PBA Percy	0.37	470	-80
Lentil	PBA Hallmark	0.39	600	32
Faba Bean	PBA Samira	0.36	590	-98
Lupin	-	Nil	450	-

Implications for commercial practice

The 2019 season was very challenging with the site receiving less than 100mm growing season rainfall and frost impacting the site during the flowering and early grain fill period. The challenging seasonal conditions has limited yields achieved in the break crops for the second successive season.

YEAR 1: 2018

Key Messages

- Low growing season rainfall restricted the yields of all break crops at Sedan in 2018
- Canola was the best performing break crop with Pioneer 43Y92 yielding 0.42t/ha
- PBA Twilight field pea was the only pulse variety to yield more than 0.3t/ha.
- A narrow range of yields were achieved across the best performing break crop however the gross margins varied widely from -\$119/ha for chickpea to \$25/ha for canola. Faba bean was almost a total crop failure due to the dry conditions.

About the trial

Six replicated trials and two demonstration trials were implemented in the Murray Plains district in 2018 near Sedan at a site with a sandy clay-loam soil. Five replicated trials evaluating the leading commercial varieties of canola, chickpea, field pea, lentils and vetch were implemented along with an unreplicated faba bean demonstration.

A field pea blackspot management trial was also established at the site. This trial compared fungicide products (Aviator® Xpro®, AmistarXtra® and Mancozeb) applied six weeks after sowing (WAS) or 6 WAS and early flowering. These products were compared to a no-spray control and a no-disease control which was implemented by applying chloranil each fortnight. All treatments had P-Pickle T® applied as a seed dressing except for the no-spray treatment, however a no-spray treatment was also included which had P applied as a P-Pickle T® applied as seed dressing.

A replicated pre-emergent herbicide demonstration trial was also established where simazine, diuron, metribuzin, terbuthylazine and isoxaflutole were applied at a low, high and twice label rate to lentil, field pea, chickpea and vetch. Each product was applied by incorporating by sowing or post-sowing, pre-emergent.

All trials were sown on May 26, except for the herbicide demonstration which was implemented on May 22. Sufficient rainfall was received soon after sowing to achieve sufficient germination across all trials. All trials were sown with 50kg/ha of Granulock Z with canola trial also receiving 178.5kg/ha of urea applied in crop. Weeds were controlled with a knockdown application of glyphosate prior to cropping with in-crop grass weeds controlled with clethodim and haloxyfop. Broadleaf weeds were managed with pre-emergent herbicides specific to each crop. Insects were controlled with two applications of alpha-cypermethrin insecticide during spring while aphids were also controlled in canola with pirimicarb. Regular application of chlorothalonil fungicide were applied to chickpeas to prevent the development of ascochyta.

All trials were harvested on November 12 except for the chickpea variety trial which was harvested on November 29. Additional biomass cuts were collected from the vetch variety trial on September 21 to assess the grazing potential of each variety.

Gross margins were calculated for each crop type using the yield of the best performing treatment from the six variety trials. Gross margins were calculated using the Rural Solutions Farm Gross Margin and Enterprise Planning Guide. Gross margins used the January grain price from the year following each trial.

Results & Discussion

Seasonal conditions were very challenging in 2018 with approximately 120 mm of growing season rainfall recorded at the site. Furthermore, rainfall events were often small and infrequent and, as a result, productivity of the break crops was low.

Management trials

Seasonal conditions in 2018 did not favour the development of disease in pulse crops and therefore there were no significant differences between treatments in the field pea blackspot management trial. Furthermore, low rainfall and a lack of intensive rainfall events limited the activity and movement of pre-emergent herbicides. Therefore, there were few visual effects in the pre-emergent herbicide trial. Most notable was damage to all crops by terbuthylazine at the twice label rate when the herbicide was applied post-sowing pre-emergent. Damage was mitigated when the herbicide was applied by incorporating by sowing.

Profitability

Canola, field pea and vetch were the most profitable break crop options, returning a small gross margin profit of \$7-\$25/ha. Lentils returned a small loss of \$42/ha. Despite similar yields to most other break crops, chickpea made a loss of \$119/ha, largely due to the high seed costs (\$90/ha) to plant this crop in 2018. At the beginning of the season, chickpea prices were very strong at \$900/t while other pulse crops such as field pea, lentil and vetch had comparatively low prices. Chickpea resistance to the disease ascochyta has also broken down in recent seasons, therefore additional fungicides need to be applied to prevent the development of the disease which also increases the gross margin costs of growing this crop. Faba beans also made a significant loss due to almost total crop failure. Although a yield of 50kg/ha was measured, in a commercial situation they would not have been harvested.

Implications for commercial practice

The 2018 season was very poor in terms of rainfall and this is reflected in the yields achieved in the break crops. With the exception of faba bean, which resulted in a total crop failure, a narrow range of yields were achieved across the best performing varieties for each crop, from 0.21 t/ha for Striker chickpea to 0.42 t/ha for Pioneer 43Y92 canola. However, the gross margins achieved for the different crop options varied widely from -\$119/ha for chickpea to \$25/ha for canola. The wide range of gross margin outcomes was largely due to high price volatility which effects both income and costs and highlights the need for a diversity of break crops to be integrated into low rainfall farming systems.

Conclusions Reached &/or Discoveries Made (Not to exceed one page)

Implications for commercial practice

Long term gross margins and risk

To understand the financial risk of growing pulse crops in the longer term, a gross margin analysis was undertaken using Monte Carlo simulation with the Microsoft Excel add-in @Risk for Year 3 of the trial. The data generated by this project was combined with data from other low rainfall Mallee sites dating back to 2013 to generate a long-term yield probability. A long-term grain price distribution was also developed for each crop using long-term (2003 – 2020) average January grain price from the Farm Gross Margin and Enterprise Planning Guide (Rural Solutions). The gross margin analysis was then repeated 5000 times for each crop, drawing a new random yield by price combination each time from the distributions described above to generate a new gross margin distribution. The outcome of this analysis is shown in Table 3.

This analysis shows that lentils are predicted to be both the most profitable and least risky pulse crop grown in the long term. The average long term gross margin for lentils is predicted as \$365, however importantly a negative gross margin is expected only 15% of the time. Conversely lentils also have a strong possibility of achieving a high gross margin with a gross margin of more than \$500/ha probable 28% of the time.

Vetch was the next most profitable break crop with an average gross margin of \$255/ha (Table 3). However, vetch as grain is predominantly sold for seed to plant fodder and hay crops. While there have been some high prices received for vetch, the grain market is limited and becomes easily flooded, which is not reflected in the @Risk simulation.

Chickpea and field pea had similar profitability and risk outcomes with both having a mean long-term gross margin of about \$200/ha (Table 3). Both crops also had similar risk of not achieving a break-even gross margin (25%) while both crops had an 15% probability of the gross margin exceeding \$500/ha. Despite both crops having a similar profitability and risk profile, our observations from the trials were that they could be complementary within a farm enterprise mix. Field pea, which flowers and matures earlier, tended to perform well in frost-free situations with terminal drought and/or high levels of heat in spring. Conversely, chickpea which flowers and matures later, performed well at sites which were frosted in early spring or in situations where soil moisture was available late in the season.

Lupin and faba bean had lowest simulated long-term gross margins of \$65/ha (Table 3). Faba bean were also the riskiest crop and are expected to not break even in 49% of seasons. Lupin has the lowest probability of achieving a high gross margin of more than \$500/ha. This is due to low long term price outcomes for lupins relative to other pulse crops.

Table 3. Mean gross margins for pulse crops and the probability of gross margin which are less than \$0/ha or greater than \$500/ha generated with @Risk simulations.

Crop	Mean Gross Margin \$/ha	Probability Gross margin <\$0/ha	Probability Gross margin <\$0-500/ha	Probability Gross margin >\$500/ha
Lentil	365	15%	57%	28%
Vetch	255	23%	60%	15%
Chickpea	220	24%	60%	15%
Field Pea	174	27%	62%	10%
Faba Bean	65	49%	46%	5%
Lupin	65	40%	58%	2%

Intellectual Property

Please provide concise statement of any intellectual property generated and potential for commercialisation.

No IP with potential for commercialisation was generated.

Application / Communication of Results

A concise statement describing activities undertaken to communicate the results of the project to the grains industry. This should include:

- Main findings of the project in a dot point form suitable for use in communications to farmers;
- A statement of potential industry impact
- Publications and extension articles delivered as part of the project; and,
- Suggested path to market for the results including barriers to adoption.

Note that SAGIT may directly extend information from Final reports to growers. If applicable, attach a list of published material.

Application

Poor seasons during the trial period actually presented some interesting conditions under which we could observe different pulses and assess their fit and profitability. Seeing these options in the worst of conditions actually provided confidence to growers in the region to sow more pulses in 2021. Some producers have sown pulses, particularly lentils, for the first time as a result of this investment. Here's a snapshot of comments from growers:

The trials sparked my interest in lentils as another potential break crop in our continuous cropping rotation. They performed better financially against other legumes in some pretty tough seasonal conditions. By having the trial locally and being able to discuss the agronomic requirements through the Pulse Check group which visited the site, it gave me the confidence to give them a go. This year we have sown 25ha to lentils in a paddock of peas to better understand how they perform and fit into our rotation with a view to significantly expand the area in 2022."

- Matthew Starick, Kongolia Farms, Punthari

We really valued the ability to see different break crops in different soil types and situations. Before we decided on which one to grow, it was good to see the options that might suit us, together with the gross margins. The profitability aspect was really important for us because we had not been clear on which option had potential to make us money, but also combine with our sheep business. We had started growing Arrowleaf clover as this trial started and the last year when the small pasture demo was included really opened our eyes to the potential of mixed species pastures, which is what we've experimented with this year.

- Anthony Pym, Heathlyn, Rockleigh

We were looking for alternatives for peas as a break crop because in recent years they'd been frosted and just generally didn't yield too well. We'd also tried chickpeas but they didn't suit our heavy soil types in short springs. The trial meant we could see a range of different pulses in action and also know whether they were going to be profitable or not. We are going to try lentils next year and we were really surprised with how profitable they can still be in this area even in dry years.

- Luke McGorman, Milendella

I am involved in a family farm on the Murray Plains, near Angas Valley. I visited the SAGIT Profitable Pulses trials each year they were planted. It was very helpful to see trials of plants not widely grown in this area. The seasons experienced whilst the trials were held were typical 'tough' ones that are common for this region.

The take home messages for me were regarding the likelihood of achieving a profit growing the various crops, the likely size of losses, and the likely size of profits in 'good' seasons. With this knowledge learnt we have planted a paddock of lentils in 2021 on our farm for the first time.

- Daniel Nuske, Black Hill

The Murray Plains farmers group had a project trialing pulses in the Murray Plains districts over the last three years. As a result of these trials, I was encouraged to try a new variety of vetch, called STUDENICA. I think this would be a great fit for our farm when considering sheep feed grazing paddocks because of its winter growth biomass characteristics and its general vigour compared to the varieties we had previously grown. Another pulse crop trial that

seemed viable was the faba beans, which I had not considered before. It seemed to survive the latest drought which shows the high level of tolerance a pulse variety needs to do well in this climate, including the occasional frost. We have included them in our seeding program this year with 10ha sown, and are yet to see how they perform in our more marginal areas of the farm.

- Adrian Bormann, Milendella

I would like to say thanks for running the profitable pulse trials in our area. Coming from a farm at Sedan and north of Sedan, I've been on the hunt for a break crop that will cope in a limestone rubble base soil and still be profitable. I tried vetch for a couple of years and was not getting the results that people 20km south were achieving. So, I decided to give chickpeas a try since there wasn't anyone else nearby that was growing them and they seemed to hold up well in the trials. I have managed to get more than seed back in a string of drought years and this year they are looking reasonably good for a late start.

I have also taken the use of Gibb acid from the trial to speed up the growth of the sown feed paddocks of vetch in the cold winter months to get it growing for sheep feed. It was very interesting the difference it makes. I had never heard of it before I saw it in the trial in 2018. I would just like to say a big thanks for running the trials and widening my eyes to look out of the normal and try different things and being able to make my farm better from it.

- Daniel Seidel, Sedan

Communication of results

Murray Plains Farmers hosted two events in 2020 which showcased the trial and communicated results to producers as well as highlighting SAGIT's role in R,D&E in South Australia.

The 2020 Crop Walk was held on the afternoon of Friday 18 September 2020 (see flyer below). It was held following a PIRSA-funded livestock producer technology morning. Overall, the day attracted the most attendees to a MPF event so far – with 80 producers and industry people from Palmer to Callington. SAGIT's support through the trial was promoted on the event flyer and its support of the trial was acknowledged at the site visit and the crop walk dinner. In addition, a SAGIT sign was placed on the fence of the trial site for the year to raise awareness of the investment.



LIVESTOCK TECHNOLOGY GROUP AND SPRING CROP WALK

FRIDAY 18 SEPTEMBER 2020

Livestock Producer Technology Group

Meeting 1: eID for Sheep

STARTING AT 9.30am
CAMBRAI SPORTSGROUND

Facilitators: Ben Hebart and Nick Paltridge, PIRSA Red Meat and Wool Program

Speaker: Michelle Cousins, Cousins Merino Services

AGENDA

- Introduction to the Red Meat and Wool Growth Program
- Group discussion of livestock technologies of most interest to the group
- eID and related equipment - how eID and individual records can drive flock productivity

11.30am: EARLY LUNCH

Murray Plains Spring Crop Walk

LEAVING FROM CAMBRAI SPORTSGROUND AT 12.15pm

Facilitator: Tony Craddock, Pinion Advisory

SITE VISITS

- 12.30pm: Reefinator site visit at John and Shane Rathjen's, Black Hill
- 1.15pm: Canola varieties and agronomy discussion at Starkeys, Paynes Rd, Sanderston
- 2.15pm: Flexi-Coil site visit at Mannum, meet at the main office
- 3.30pm: Leave Mannum for Palmer trial sites
- 3.45pm: GRDC National Variety Trial - Wheat and Barley and SAGIT Profitable Pulses near Western Boundary Road
- 5.30pm: BBQ at Reedy Creek shearing shed (Steen and Deanna Paech) thanks to Ronco Motors. Please BYO chair.



These events are free. To attend either or both, RSVPs are essential for catering purposes before Wednesday 16 September to Zoe Starkey, 0448 964 311 or email mpfarmers@outlook.com



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The final results of the project were presented by Michael Moodie at the Post-Harvest Seminar at Cambrai on 29 January 2021. It attracted 50 people. There was much interest in the results of the trial, and in particular the profitability analysis.

POST-HARVEST SEMINAR

Friday
29 January 2021

Cambrai Sports Ground
5.30pm for a 6pm start



 MURRAY PLAINS FARMERS



Michael Moodie,
Frontier Farming Systems



Tim and Cheryl Freak,
Coomandook

5.30pm: **Doors open**

6.00pm: **Meals are served**

7.00pm: **Profitable pulses for the Murray Plains**

Michael Moodie will deliver the verdict on which has been the most profitable pulse for the past three years. The final year of the SA Grain Industry Trust-funded pulse trial was hosted at Palmer.

7.30pm: **Barley and wheat NVT results**

For the first time in 2020, the GRDC-funded National Variety Trial included full sites of both barley and wheat. Find out which varieties yielded the best as SARDI outlines the results.

8.00pm: **Break**

8.30pm: **Profitability, succession and ramping up a sheep enterprise ...**

Farmers and business coaches Tim and Cheryl Freak, Coomandook, will share their insights on how they ramped up their sheep enterprise in the past few years, doubling their stocking rate to 6DSE/ha and consistently retaining 30-45% of their turnover as profit. They also have a unique and innovative succession planning story which has enabled them to create the ultimate 'freedom farm'.

9.30pm: **Close**

This event is **FREE** but registration is essential by January 26 for catering and COVID tracing. **Register online.** For more information, contact MPF Coordinator Zoe Starkey at mpfarmers@outlook.com or 0448 964 311. All welcome!



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POSSIBLE FUTURE WORK

Provide possible future directions for the research arising from the project including potential for further work and partnerships.

The 2020 pasture demonstration trial then led MPF to apply for a pastures trial in the latest round of funding. In discussion with the SAGT trustees, it was observed that when not in crop, paddocks in the Murray Plains are often left to a weedy fallow, rather than productive pastures. This led to the application – which was successful, with a demonstration trial currently being grown near Palmer's barley and wheat NVT site in 2021, managed by AgXtra.