Loxton, South Australia
Low Rainfall Zone, Mallee

All pulses were sown into subsoil moisture which enabled timely establishment of all pulse crops in early May. However, the remainder of the 2024 season was very dry, especially during the latter part of the growing season (Aug and Sept; Figure 1). Only 17 mm of rainfall was recorded during this period. Moisture stress during the late winter – spring period was compounded by both high temperatures in early September and severe frost in mid – September. Despite the challenging climate conditions grain yields of chickpea (0.74 t/ha) and field peas (0.70 t/ha) achieved the estimated yield potential (Yp) of 0.74 t/ha. Lentil yields averaged 0.45 t/ha.

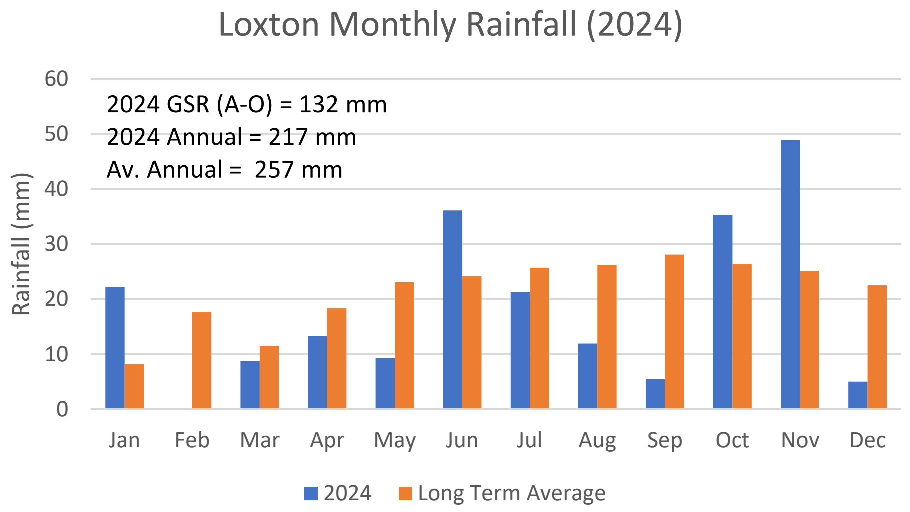

Figure 1. Monthly rainfall (blue) (mm) recorded at Loxton in 2024 compared to the long-term average rainfall (orange) at the Loxton Research BOM site (#024024).

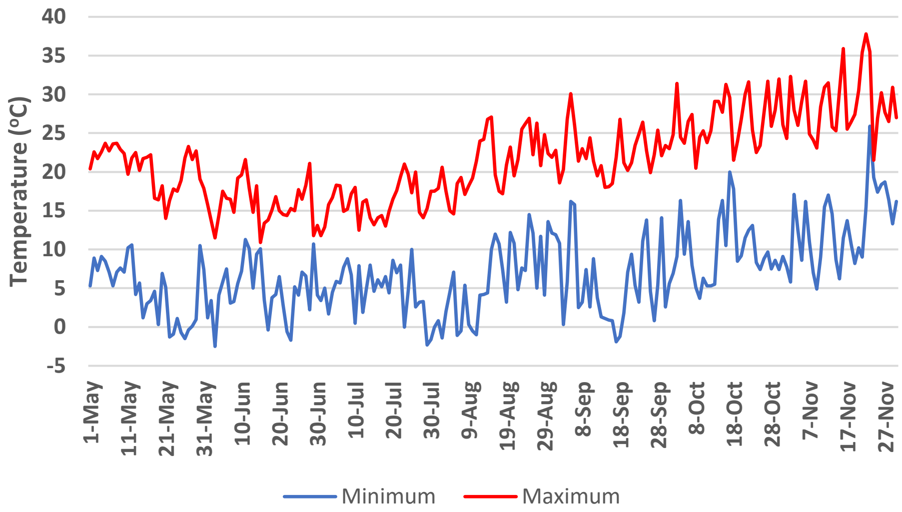

Figure 2. Minimum and maximum temperature (°C) recorded during the growing season 2024 at the Loxton Research BOM site (#024024).

Table 1. Soil properties at the Loxton hub trial site, 2024.

Depth (cm)	NH_3-N	NO_3-N	P (mg/kg)	K	S	OC (%)	EC (dS/m)	pH ($CaCl_2$)	pH (H_20)	
0-10	15	<1.0	20	221	3.6	0.55	2.8	8.0	8.6	
10-20	6.6	<1.0		155	2.8		2.3	8.0	8.7	
20-40	5.6	<1.0		123	<2.5		1.4	8.1	8.8	
40-60	5.4	<1.0		100	3.5		1.7	8.2	9.0	
60-80	2.4	<1.0		142	3.5		3	8.4	9.6	
80-100	<1.0	<1.0		194	2.8		4.6	8.4	9.9	
Depth	**Cu**	**Fe**	**Mn**	**Zn**	**B**	**Exc Ca**	**Exc Mg**	**Exc K**	**Exc Na**	**Exc Al**
(cm)			**(mg/kg)**					**(cmol/kg)**		
0-10	0.13	2.7	2.4	0.91	1	15	1.3	0.6	0.1	<0.02
10-20					1	20	1.2	0.4	0.1	<0.02
20-40					1	20	1.8	0.3	0.1	<0.02
40-60					1	20	4.1	0.3	0.3	<0.02
60-80					3	18	5.3	0.4	1.2	<0.02
80-100					6	17	4.7	0.5	2.1	<0.02

Nutrition x Deep Ripping in lentils and barley across multiple soil types

Authors

Michael Moodie and Jason Brand, Frontier Farming Systems

Aim

To evaluate the grain yield response of lentils and barley to deep ripping and nutrition (phosphorus & trace elements) across soil types commonly encountered in Mallee paddocks.

Methodology:

Trial details are provided in Table 2. The trial was first established in 2023 with separate sites for lentil and barley. Each site consisting of six sub trials transversing the landscape from a clay loam soil type on the swale to a deep sandy soil on top of a dune. In 2024, the treatments were repeated however the crop types were swapped so that lentils were grown where barley was sown the previous year and barley was grown where lentils were the previous season. Grain yield was measured for each sub-trial using a plot harvester. Each sub-trial was analysed independently using *a two-way ANOVA in Genstat 24th Edition.*

Table 2. Trial details, Loxton 2024.

Trial design	RCBD
Plot size	10 m x 1.68 m
Replicates	3
Sowing date	16/5/24
Plant density	Lentil & Barley: 120 plants/m^2
Row spacing	28 cm
Fertiliser	See Treatments (Table 2, Table 3).
Harvest date	1/11/24

Treatments:

Trials compared nutritional treatments for lentil and barley grown on a range of Mallee soil types with and without deep ripping. There were six sub trials located on soil type transitioning across a 70 m transect from the clay loam soil on the swale to the deep sandy soil located on the top of a dune. The average composition of sand, clay and silt in the top 60 cm of soil at each landscape position is shown in Table 3. Deep ripping treatments were implemented prior to sowing 2023 to a depth of 50 cm using Tilco straight shank tynes. They were not repeated in 2024.

Table 3. Average sand, clay and silt percentage in the 0-60 cm soil at each landscape position.

Texture	**Landscape Position** *(1 = swale, 6 = dune)*					
	1	2	3	4	5	6
Sand (%)	69	74	80	85	90	91
Clay (%)	19	16	13	9	5	5
Silt (%)	12	10	8	6	5	4

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There were also five nutrition treatments (Table 43), which included Monoammonium Phosphate (MAP) and Sulphate of Ammonia (SOA) banded below the seed at seeding and liquid trace elements which were applied both in-furrow at seeding and in-crop as a foliar application. The lentil site was sown to the variety GIA Lightning and the barley site was sown to the variety Titan AX.

Table 4. Nutrition treatments applied to lentil and barley.*

<table>
<tr><th>Treatment No.</th><th>Treatment Description</th><th>MAP (Banded)</th><th>SOA (Banded)</th><th>Liquid Inject (In furrow)</th><th>Liquid Foliar</th></tr>
<tr><td>1</td><td>Nil</td><td>Nil</td><td></td><td colspan="2" rowspan="4">Nil</td></tr>
<tr><td>2</td><td>MAP (Low)</td><td>25 kg/ha</td><td></td></tr>
<tr><td>3</td><td>MAP (High)</td><td>50 kg/ha</td><td></td></tr>
<tr><td>4</td><td>MAP (High) + SOA</td><td>50 kg/ha</td><td>50 kg/ha</td></tr>
<tr><td>5</td><td>MAP (High) + SOA + ZMC + Mo</td><td>50 kg/ha</td><td>50 kg/ha</td><td>Sipcam Multisol @ 8 L/ha + Sipcam Amino Boss Moly @ 0.8 L/ha</td><td>Sipcam Amino Boss ZMC @ 4 L/ha + Sipcam Amino Boss Moly @ 0.8 L/ha</td></tr>
</table>

**All barley treatments received an additional 150 L/ha of UAN (64 kg N/ha) throughout the season*

Key messages

- *Lentil yields were very low and ranged from 0.5 t/ha on the heavier soils to less than 0.1 t/ha on the deepest sand. The second-year benefits from deep ripping improved lentil yield by 0.1 t/ha on the sandy soils only.*
- *Second year benefits from deep ripping in barley were 0.2 t/ha representing a 15 – 25% increase in grain yield.*
- *Barley was responsive to MAP across all soil types. MAP only significantly increased lentil grain yield on one of the landscape positions tested (position 5).*
- *There was no grain yield response of lentils or barley to SOA or trace elements*

Results and Discussion:

Deep ripping improved the grain yield of both lentils and barley (Tables 5 & 6), but only on the sandiest soils located on mid-slope and top of the sandy dune. For lentil, this corresponds with landscape positions 4 – 6, while barley yields benefited from deep ripping from landscape positions 3 - 6. These soil types had a soil texture with more than 80% sand in the top 60cm of soil. Lentil yields were very low (<0.5 t/ha), however deep ripping significantly increased grain yield by 0.1 t/ha.

Barley yield was also improved by deep ripping on the sandy soils. Barley grain yields on the sandy soil types, ranged from 1.1 – 2.0 t/ha. Deep ripping improved these grain yields by 0.2 t/ha which represented a yield improvement of 15 – 25%. Deep ripping soil types with higher clay content (landscape position 1) resulted in a yield penalty in barley.

There was a grain yield response in lentil to the application of MAP at landscape Position 5 (Table 7). Lentil yielded highest in the treatment with 50 kg/ha of MAP applied.

Barley grain yield was more responsive to MAP application, with this benefit observed across most soil types (Table 8). Generally, the application of 25 kg/ha of MAP increased yield significantly relative to the nil treatments and yield was not improved by applying 50 kg/ha of MAP. There was no evidence that the application of SOA or trace elements improved the grain yield of either lentils or barley. There was also no interaction between deep ripping and nutrition treatments for either crop.

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Table 5. Effect of deep ripping on lentil grain yield (t/ha) across the six landscape positions. n.s. = not significant.

Treatment	**Landscape Position** *(1 = swale, 6 = dune)*					
	1	*2*	*3*	*4*	*5*	*6*
No Rip	0.48	0.40	0.38	0.21	0.09	0.05
Deep Rip	0.50	0.43	0.45	0.30	0.14	0.08
P value	0.549	0.254	0.007	<.001	<.001	0.004
LSD (p<0.05)	n.s	n.s	0.04	0.03	0.02	0.02

Table 6. Effect of deep ripping on barley grain yield (t/ha) across the six landscape positions. n.s. = not significant.

Treatment	**Landscape Position** *(1 = swale, 6 = dune)*					
	1	*2*	*3*	*4*	*5*	*6*
No Rip	1.71	2.01	2.19	1.96	1.23	1.10
Deep Rip	1.61	1.95	2.16	2.23	1.47	1.36
P value	0.051	0.523	0.541	<.001	0.003	0.005
LSD (p<0.05)	0.11	n.s	n.s	0.14	0.15	0.17

Table 7. Effect of nutrition treatments on lentil grain yield (t/ha) across the six landscape positions. n.s. = not significant.

Treatment	**Landscape Position** *(1 = swale, 6 = dune)*					
	1	*2*	*3*	*4*	*5*	*6*
Nil	0.43	0.38	0.38	0.23	0.08	0.05
MAP 25 kg/ha	0.52	0.44	0.40	0.28	0.11	0.08
MAP 50 kg/ha	0.50	0.43	0.46	0.27	0.16	0.06
MAP 50 kg/ha + SOA 50 kg/ha	0.50	0.41	0.42	0.24	0.10	0.06
MAP 50 kg/ha + SOA 50 kg/ha + Trace Elements	0.51	0.42	0.44	0.25	0.11	0.06
P value	0.596	0.634	0.16	0.277	0.005	0.486
LSD (p<0.05)	0.12	0.09	0.07	0.05	0.04	0.03

Table 8. Effect of nutrition treatments on barley grain yield (t/ha) across the six landscape positions. n.s. = not significant.

Treatment	**Landscape Position** *(1 = swale, 6 = dune)*					
	1	*2*	*3*	*4*	*5*	*6*
Nil	1.48	1.69	1.78	1.75	1.01	1.03
MAP 25 kg/ha	1.72	2.02	2.22	2.17	1.32	1.22
MAP 50 kg/ha	1.78	2.22	2.29	2.09	1.55	1.36
MAP 50 kg/ha + SOA 50 kg/ha	1.67	1.93	2.32	2.25	1.44	1.36
MAP 50 kg/ha + SOA 50 kg/ha + Trace Elements	1.65	2.02	2.25	2.21	1.43	1.18
P value	0.018	0.035	<.001	0.001	0.002	0.099
LSD (p<0.05)	0.17	0.31	0.16	0.22	0.24	0.27

Acknowledgements

Thank you to Tarree Pastoral for hosting these trials.

Thank you to Dr Sean Mason (Agronomy Solutions) for assistance with interpretation of soil tests.

Thank you to SIPCAM for supplying trace elements products used in the trial.

Optimising seeding rates with and without disease management to manage risk in chickpea

Authors

Jason Brand & Michael Moodie, Frontier Farming Systems

Aim

To evaluate if lower seeding rates and ascochyta blight resistance can reduce the risk of growing high value chickpeas in the low rainfall South Australian Mallee.

Methodology:

Trial details are provided in Table 9. Plant establishment was measured from the four internal crop rows using two quadrat (2 rows x 1 m) drops per plot. Peak Biomass was recorded Oct 1 in the complete fungicide control treatments by cutting 6 rows x 1m and drying at 70^{O}C. Grain yield was measured using a plot harvester. Data was analysed with a three-way *ANOVA in Genstat 24th Edition.*

Table 9. Trial details, Loxton 2024.

Trial design	Split Plot
Plot size	10 m x 1.68 m
Replicates	4
Sowing date	07/05/24
Plant density	See treatments
Row spacing	28 cm
Fertiliser	Granulock SZ (12 (N), 18 (P), 0 (K), 8 (S) + 1% Zn) @ 50 kg/ha
Harvest date	04/12/2024

Treatments:

Genesis 090 (Kabuli chickpea), CBA Captain (Desi chickpea), ABR Desi (new breeding line; Ascochyta blight resistant Desi chickpea) and EMPTT Desi (new breeding line; early podding trait) were each sown at three different seeding rates which aimed to establish each variety at plant densities of 15, 35 and 55 plants/m^2 (Table 10). Each set of variety x density combinations had complete fungicide control (22 July - Veritas Opti @ 400 ml/ha; 7 August – Miravis Star @ 500ml/ha; 13 September – Chlorothalonil @ 800ml/ha) compared with untreated.

Table 10. Seeding rates used for each treatment at Loxton 2024.

Variety	Seed Weight (g/1000 seeds)	Target Plant Density (plants/m^2)	Seeding Rate (kg/ha)
Genesis 090	290	15	61
		35	107
		55	152
CBA Captain	195	15	41
		35	72

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		55	103
ABR Desi	210	15	44
		35	77
		55	110
EMPTT Desi	242	15	51
		35	89
		55	127

Key messages

- *Chickpea establishment declined from 100 % of the target when a low plant density was used (20 plants/m^2) to 67% where the density was high (55 plants/m^2).*
- *There was no effect of disease management in the dry season in 2024.*
- *Peak biomass was optimised by higher plant densities across all varieties. The early podding line showed higher earlier vigour and slightly higher biomass than other varieties.*
- *Grain yield response to plant density was varietal related. The earlier maturing and more erect varieties/lines, CBA Captain and EMPTT were more responsive to plant density. The later maturing Desi line with Ascochyta blight resistance and a more spreading architecture had consistently higher grain yield*

Results and Discussion:

At the lowest target plant density (15 plants/m^2) all seed established, however at the higher target densities only 85% and 67% establishment was seen resulting in actual establishment 30 plants/m^2 and 37 plants/m^2, respectively (Figure 3).

Peak biomass varied between variety and plant density (Figure 4). Generally, Genesis 090 produced the lowest biomass, while the early podding Desi breeding line, 'EMPTT' had the highest biomass. In observations, this line also appeared to have improved early vigour. For all varieties the highest plant density resulted in the highest biomass, ranging from 1.33 t/ha for Genesis090 to 1.83 t/ha for EMPTT. In both, EMPTT and CBA Captain biomass was reduced by 12% in the 35 plants/m^2 treatment and 30% in the 15 plants/m^2 treatment. For both Genesis090 and the Ascochyta blight resistant Desi line 'ABR' there was no difference between the lower densities. They were 30% lower for Genesis090 and 20% lower for ABR.

In early October, dead plants were noted throughout the trial, which were related to underlying soil constraints and landscape at the trial site. A proportion of dead plants was estimated for each plot (Table 11 and Figure 5) and this was used as a covariate when analysing the grain yield to improve comparison between varieties and other treatments. There was a significant correlation between the proportion of dead plant and grain yield on a plot scale (Figure 5). For all the varieties with low resistance to ascochyta blight there was also a significant reduction in plant death score with complete fungicide control (Table 11).

Due to the dry and frosty season there was no significant effect on grain yield of controlling ascochyta blight with fungicide. However, there was an interaction between variety and plant density. The ascochyta blight Desi ABR had the highest yield of 0.87 t/ha, which was consistent across all densities (Figure 6). Similarly, Genesis090 had consistent yields across all densities, but was the lowest yielding at 0.59 t/ha. Both CBA Captain and EMPTT had significantly lower grain yield at the lowest plant density, while yields were similar at the highest densities. The differential responses in grain yield appear to be related to plant architecture and phenology. The highest yielding line 'ABR', was slightly later flowering than CBA Captain and much later than the early flowering and podding line EMPTT. It also maintained its green leaf area later, so is likely to have set pods following the severe frosts in September. This combined with a more spreading architecture may also explain its lack of response to plant density similar to Genesis 090. Gensis090 as a small kabuli, was lower yielding due to poorer adaptability to dry regions, consistent with previous observations Both CBA Captain and EMPTT have an erect architecture and mature earlier, so had reduced yield at low plant densities.

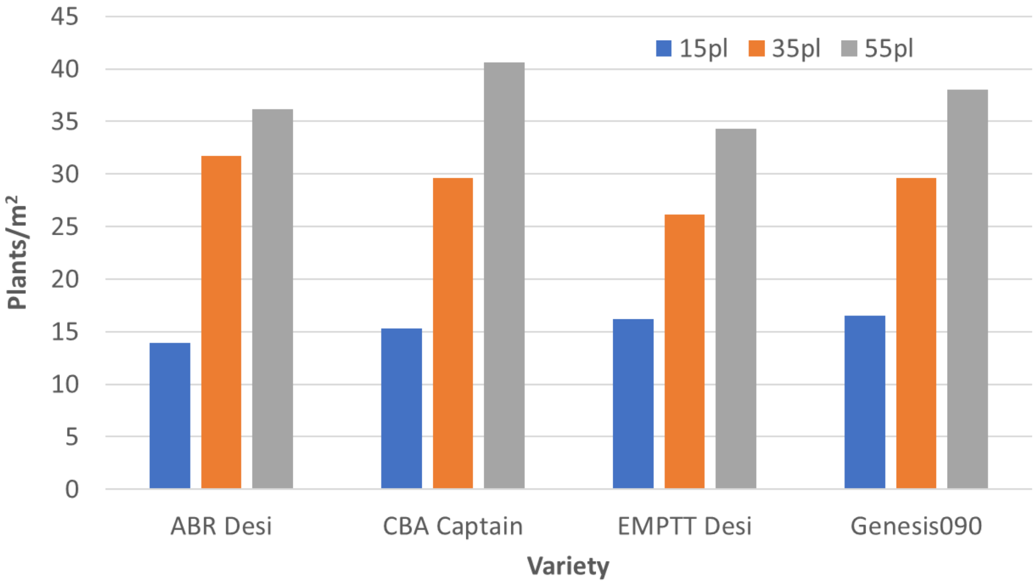

Table	Var	Fung	Den	VarxFung	VarxDen	FungxDen	VarxFungxDen
P Value	0.33	0.46	<0.001	0.75	0.35	0.67	0.59
l.s.d.(P<0.05)	ns	ns	2.8	ns	ns	ns	ns
Except when comparing means with the same level(s) of							
Var				ns	ns		ns
Fun						ns	
Var.Fun							ns
Var.Den							ns

Figure 3. Plant density (plants/ m²) achieved for each target plant density for the four chickpea varieties at Loxton in 2024 (P values and lsd indicated in table above). ns = not significant.

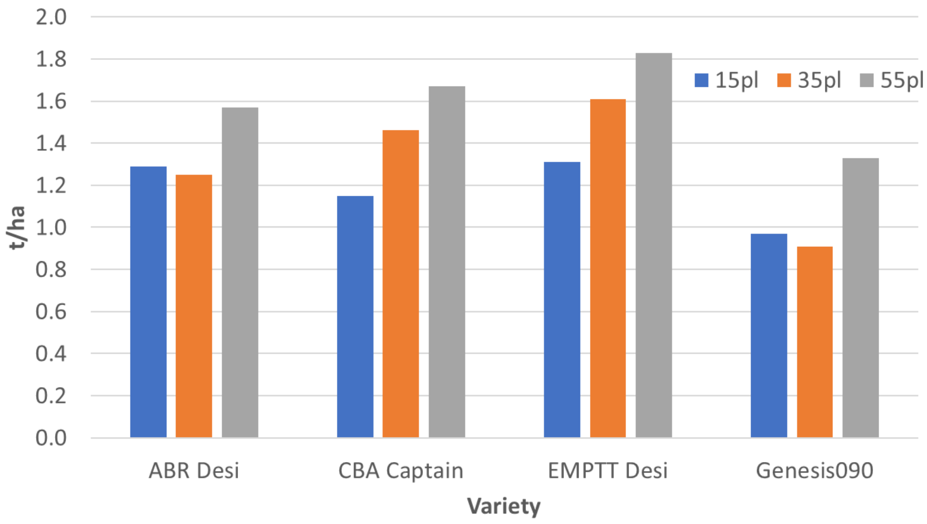

Table	Var	Den	VarxDen
P Value	0.054	<0.001	0.75
l.s.d.(P=0.05)	ns	0.20	ns
Except when comparing means with the same level(s) of			
Var			ns

Figure 4. Peak Biomass (t/ha) recorded Oct 1 for each target plant density of the four chickpea varieties at Loxton in 2024 (P values and lsd indicated in table above). ns = not significant.

Table 11. Proportion of dead plants per plot (0-100%), recorded Oct 22 in each of the fungicide and plant density treatments for the four chickpea varieties sown at Loxton in 2024 (P values and Lsd indicated in table below).

Variety	**Fungicide**	**15pl**	**35pl**	**55pl**	***Avg***
ABR Desi	Complete	20	30	23	*24*
	Nil	23	25	25	*24*
Captain	Complete	36	36	40	*38*
	Nil	55	50	45	*50*
EMPTT Desi	Complete	39	39	31	*36*
	Nil	41	43	46	*43*
Genesis 090	Complete	16	20	24	*20*
	Nil	34	33	30	*32*
	Avg	*33*	*34*	*33*	*33*

Table	Var	Fung	Den	VarxFung	VarxDen	FungxDen	VarxFungxDen
P Value	0.55	0.02	0.78	0.45	0.89	0.65	0.42
l.s.d.(P=0.05)	ns	ns	ns	ns	ns	ns	ns
Except when comparing means with the same level(s) of							
Var				ns	ns		ns
Fun						ns	
Var.Fun							ns
Var.Den							ns

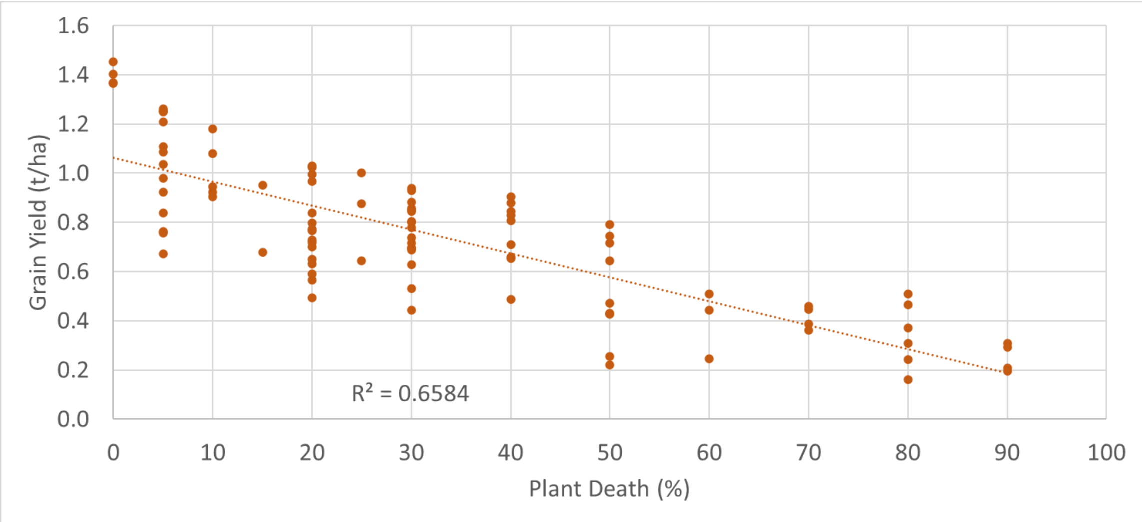

Figure 5. Relationship between the proportion of plants that had died and grain yield (t/ha) of each plot in the chickpea trial at Loxton in 2024.

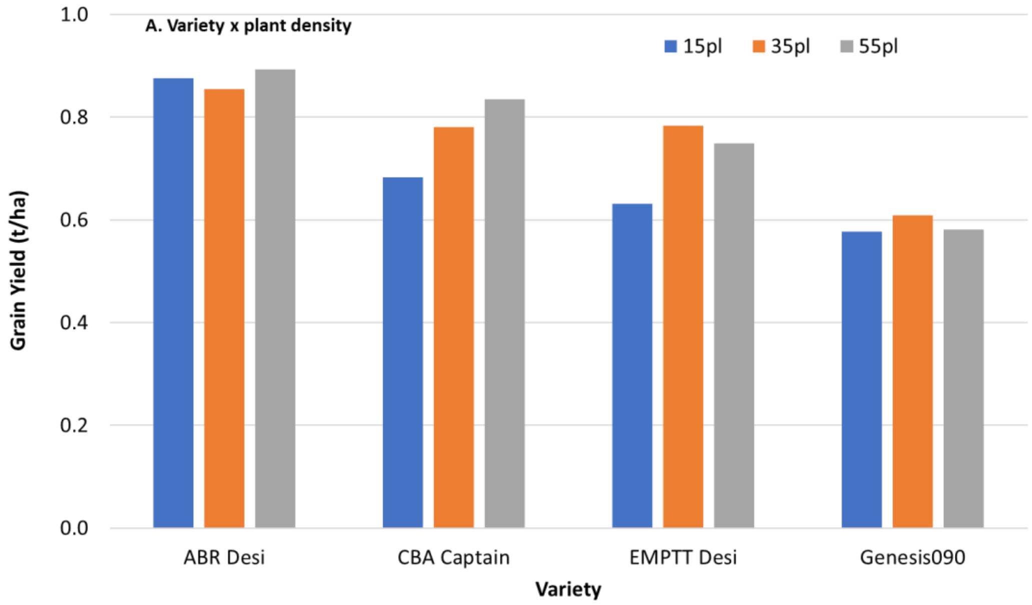

Table	Var	Fung	Den	VarxFung	VarxDen	FungxDen	VarxFungxDen
P Value	0.053	0.35	<0.001	0.67	0.02	0.07	0.79
l.s.d.(P=0.05)	ns	ns	0.04	ns	0.20	ns	ns
Except when comparing means with the same level(s) of							
Var				ns	0.08		ns
Fun						ns	
Var.Fun							ns
Var.Den							ns

Figure 6. Grain yield (t/ha) for each target plant density of the 4 chickpea varieties at Loxton in 2024. ns = not significant.

Acknowledgements

Thankyou to Tarree Pastoral for hosting this trial

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Optimising seeding rates to manage risk in Lentil.

Authors

Jason Brand & Michael Moodie, Frontier Farming Systems

Aim

To evaluate if lower seeding rates can reduce the risk of growing high value lentils in the low rainfall South Australian Mallee.

Methodology:

Trial details are provided in Table 12. Plant establishment was measured from the four internal crop rows using two quadrat (2 rows x 1 m) drops per plot. Peak biomass was recorded October 1 in the complete fungicide control treatments by cutting 6 rows x 1m and drying at 70^{O}C. Grain yield was measured using a plot harvester. Data was analysed with a three-way ANOVA in Genstat 24th Edition.

Table 12. Trial details, Loxton, 2024.

Trial design	Split Plot
Plot size	10 m x 1.68 m
Replicates	4
Sowing date	06/05/24
Plant density	See treatments
Row spacing	28 cm
Fertiliser	Granulock SZ (12 (N), 18 (P), 0 (K), 8 (S) + 1% Zn) @ 50 kg/ha
Harvest date	04/12/2024

Treatments:

GIA Thunder, GIA Lightning, PBA Hallmark XT, PBA Highland XT and ALB Terrier were each sown at three different seeding rates that aimed to establish each variety at plant densities of 60, 90 and 120 plants/m^2 (Table 13).

Table 13. Seeding rates used for each treatment.

Variety	Seed Weight (g/1000 seeds)	Target Plant Density (plants m^2)	Seeding Rate (kg/ha)
GIA Thunder	37	60	24
		90	37
		120	49
GIA Lightning	36	60	24
		90	35
		120	47
PBA Highland XT	37	60	24
		90	37
		120	49
PBA Hallmark XT	42	60	28
		90	42
		120	56

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ALB Terrier	42	60	28
		90	42
		120	56

Key messages

- *GIA Lightning had the highest yield of 0.56 t/ha, demonstrating its adaptability to lighter textured soils and potential to set yield in late in the season.*
- *Plant density had no impact on biomass or grain yield.*

Results and Discussion:

Achieved establishment averaged 52, 77 and 100 plants/m^2 and about 15% lower than the target plant densities of 60, 90 and 120 plants/m^2 (Figure 7Table 7). All varieties showed a similar response.

Peak biomass averaged 1.66 t/ha, with no significant differences between varieties and densities (Figure 8Table 8).

Grain yield was significantly impacted by frost and averaged 0.45 t/ha across the trial (Figure 9). GIA Lightning had the highest yield of 0.56 t/ha and ALB Terrier the lowest of 0.36 t/ha. There were no significant differences between plant densities in any variety. Biomass production was not correlated with grain yield. The results continue to show the adaptability of GIA Lightning to light textured soils and its potential to still set yield late in the season following frost events, due to the unique extended growth patterns of this variety that allows it to capitalise on late season rainfall events (Source: GIA Lightning variety brochure).

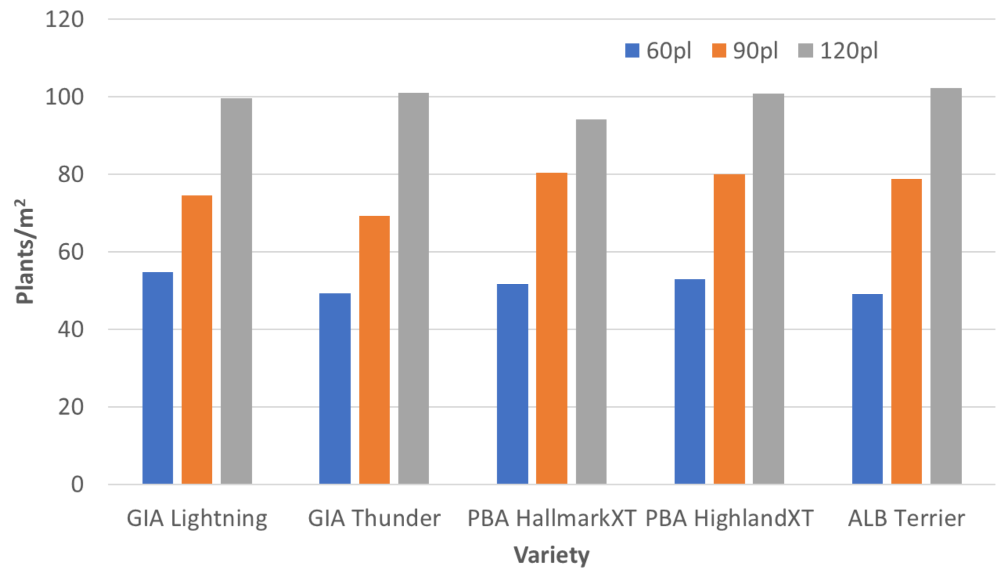

Table	Variety	Density	VarxDen
P Value	0.82	<0.001	0.78
l.s.d.	ns	14	ns

Figure 7. Plant density (plants/m^2) achieved for each target plant density for the five lentil varieties at Loxton in 2024. ns = not significant.

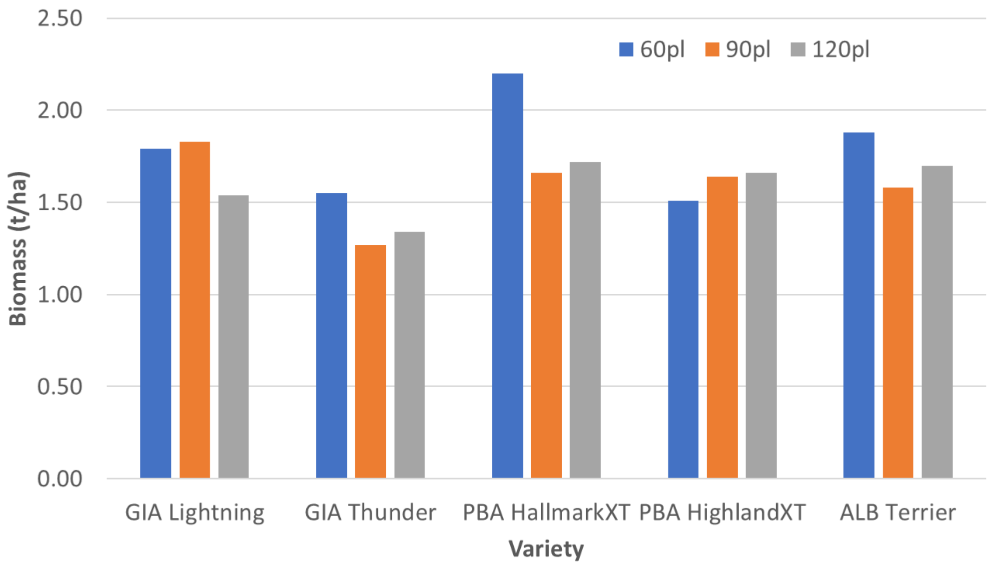

Table	Variety	Density	VarxDen
P Value	0.17	0.34	0.87
l.s.d.	ns	ns	ns

Figure 8. Peak biomass (t/ha) recorded Oct 14 for each target plant density for the five lentil varieties at Loxton in 2024. ns = not significant.

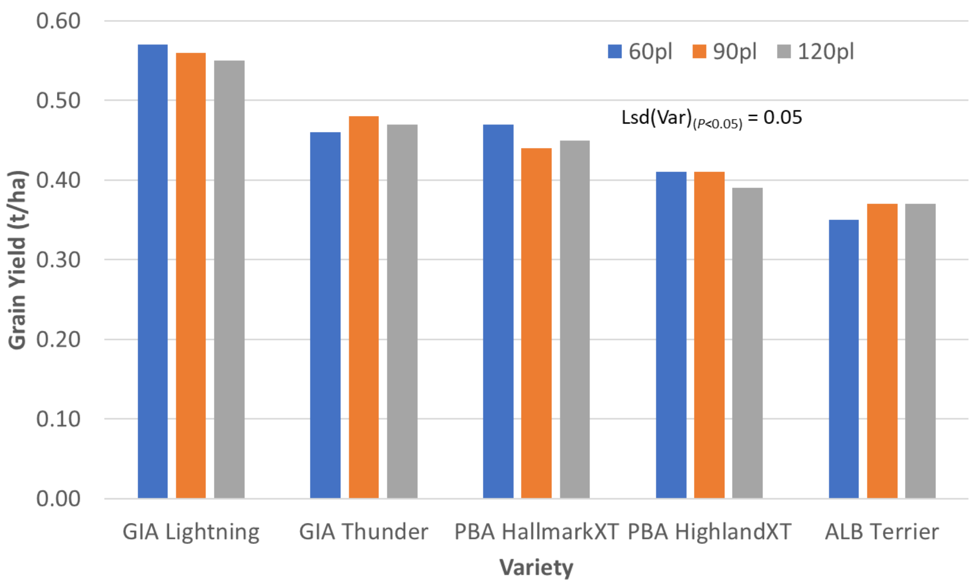

Table	Variety	Density	VarxDen
P Value	<0.001	0.93	0.99
l.s.d.	0.05	ns	ns

Figure 9. Grain yield (t/ha) for each target plant density of the five lentil varieties at Loxton in 2024. ns = not significant.

Acknowledgements

Thankyou to Tarree Pastoral for hosting this trial

GRDC Project: UOA2105-013RTX *- Development and extension to close the economic yield gap and maximise farming system benefits from grain legume production in South Australia.*

Field Pea Varieties for Low Rainfall Zone Mallee

Authors

Jason Brand & Michael Moodie, Frontier Farming Systems

Aim

To assess the best field pea varieties for the low rainfall Mallee region.

Methodology:

Trial details are provided in Table 14. Peak biomass was recorded October 1 by cutting 6 rows x 1m and drying at 70°C. Grain yield was measured using a plot harvester. Data was analysed with a one-way ANOVA in Genstat 23rd Edition.

Table 14. Trial details, Loxton 2024.

Trial design	RCBD
Plot size	10 m x 1.68 m
Replicates	4
Sowing date	07/05/24
Plant density	40 plants/m^2
Row spacing	28 cm
Fertiliser	Granulock SZ (12 (N), 18 (P), 0 (K), 8 (S) + 1% Zn) @ 50 kg/ha
Harvest date	28/10/2024

Treatments:

The trial compared eight field pea varieties:

- APB Bondi (Kaspa type, widely adapted)
- PBA Butler (Kaspa type, high yielding in NVT)
- PBA Taylor (Kaspa type, high yielding in NVT)
- PBA Twilight (Kaspa type, early flowering variety adapted to dry areas)
- PBA Noosa (Blue type, high yielding, broadly adapted)
- GIA Ourstar (Australian dun dimpled type, tolerance to imidazoline herbicides and residual sulfonylurea)
- GIA Kastar (Kaspa type, tolerance to imidazoline herbicides and residual sulfonylurea)
- GIA2203P (Kaspa type, tolerance to imidazoline herbicides and residual sulfonylurea)

Key messages

- *Grain yield of field peas was 0.70 t/ha, only slightly less than the estimated yield potential of 0.74 t/ha, despite the frosty conditions in 2024.*

Results and Discussion:

- Peak biomass ranged from 2.45 t/ha (GIA Ourstar) to 3.81 t/ha (PBA Butler) (Figure 10). There was no significant relationship with plant phenology, with early flowering varieties like PBA Twilight performing similar to mid-flowering types like PBA Butler.

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Grain yields were surprisingly good for field peas despite the frosty conditions in 2024, with an average of 0.70 t/ha (the estimated yield potential was 0.74 t/ha). There was no significant difference between varieties.

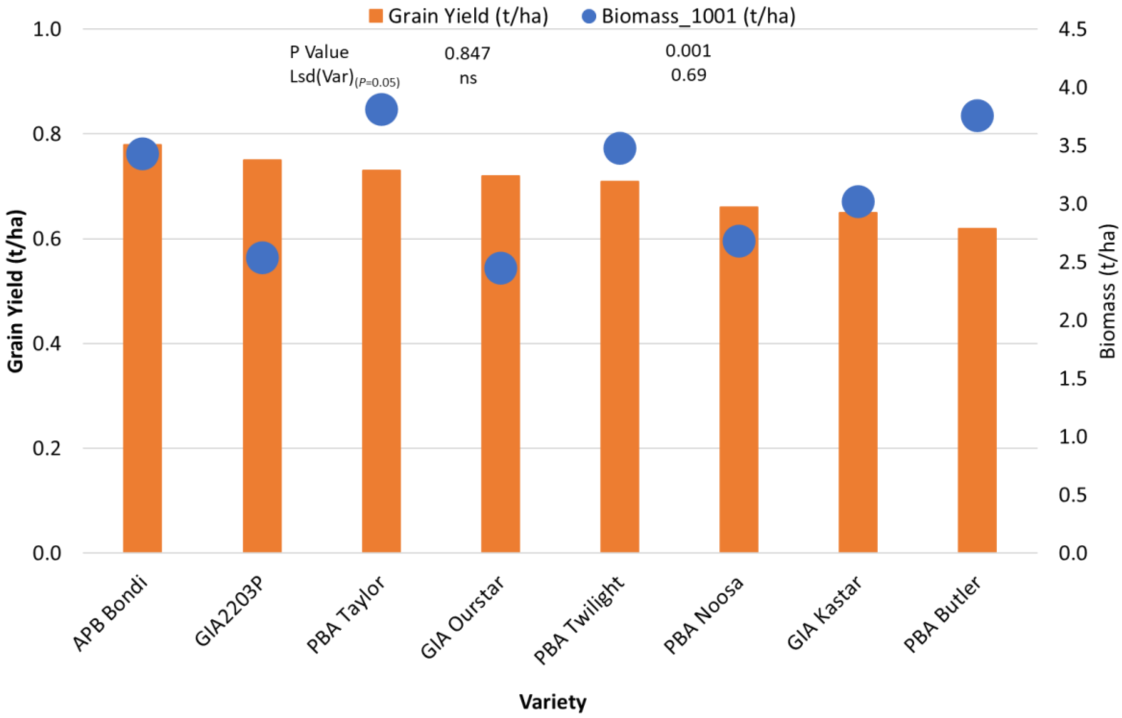

Figure 10. Peak Biomass and grain yield (t/ha) of the 8 chickpea varieties at Loxton in 2024. ns = not significant.

Acknowledgements

Thank you to Tarree Pastoral for hosting this trial.

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Pinnaroo, South Australia
Low Rainfall Zone, Mallee

The sandy topsoil at the site was acidic with a pH of around 5 ($CaCl_2$) (Table 15). Below 10 cm the soil becomes neutral to alkaline. Rainfall at the site in 2024 was only half of what is normally received (Figure 11). January and June were the only months where rainfall exceeded the monthly average with severe deficits during the growing season months of April, May, August and September. Consequently, lentil production was extremely low with average grain yields of just 350 kg/ha.

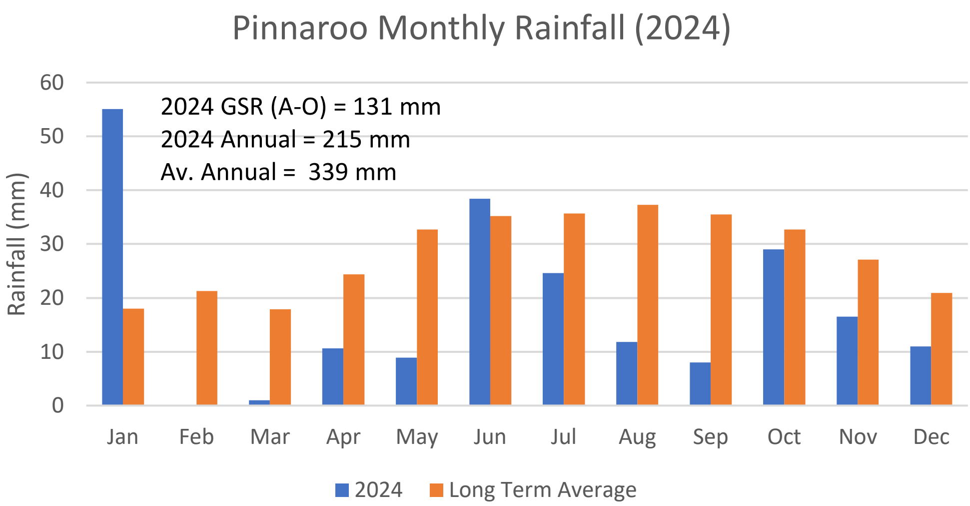

Figure 11. Monthly rainfall recorded at Pinnaroo in 2023 compared to the long-term average rainfall at the Pinnaroo BOM site (#25015).

Table 15. Soil properties of the sand soil type at the Pinnaroo demonstration site, 2023.

Depth (cm)	NH_3-N	NO_3-N	P (mg/kg)	K	S	OC (%)	EC (1:5) (dS/m)	pH ($CaCl_2$)		
0-5	31	15	38	170	3.5	0.81	0.19	5.1		
5-10	8	3.2	38	110	3.3	0.55	0.14	4.9		
10-20								6.9		
20-30								7.8		
Depth (cm)	**Cu**	**Fe**	**Mn (mg/kg)**	**Zn**	**B**	**Exc Ca**	**Exc Mg**	**Exc K (cmol/kg)**	**Exc Na**	**Exc Al**
0-5	0.31	15	0.9	0.8	2.5	7.94	3.42	0.65	0.65	<0.02
5-10	0.25	27	0.8	2	1.9	2.66	1.67	0.34	0.86	<0.02

Management strategies to overcome acidification of Mallee sandy soils

Authors

Michael Moodie and Jason Brand, Frontier Farming Systems

Aim

To demonstrate management options to overcome acidification in sandy Mallee soils to improve lentil production.

Methodology:

Trial details are provided in Table 16. Grain yield was measured using a plot harvester by taking two, 2.1 m x 88 m strips out of each plot. Data is demonstration only.

Table 16. Trial details, Pinnaroo 2024.

Trial design	Demonstration
Plot size	18 m x 90 m
Replicates	NA
Sowing date	26/04/24
Plant density	100 plants/m^2
Row spacing	17 cm (disc seeder)
Fertiliser	MAP @ 50 kg/ha
Harvest date	19/11/24

Treatments:

A range of deep ripping, spading and lime treatments were implemented in commercial scale plots of 18 m x 90 m in April 2022. The treatments were:

- Untreated Control
- Deep rip
- Spade
- Deep rip + Spade
- Lime @ 1.5 t/ha
- Spade + Lime @ 1.5 t/ha
- Lime @ 3 t/ha
- Spade + Lime @ 3 t/ha
- Lime @ 6 t/ha
- Spade + Lime @ 6 t/ha
- Deep rip + Spade + Lime @ 3 t/ha

Key messages

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- *Amelioration treatments applied in 2022 were successful in overcoming soil acidification at the site. The most effective treatments were lime surface applied at 3 t/ha and spading.*
- *Combining spading with liming raised the soil pH above 7.5. Deep ripping before spading had also made the soil alkaline.*
- *Observations during the growing season showed that lentil plants were responding in treatments where soil acidification had been overcome with improved biomass, better root systems and improved nodulation.*

Results and Discussion

All treatments except deep ripping had some effect of raising the soil pH, relative to the untreated control (Figure 12). Lime applied to the soil surface @ 1.5 t/ha successfully raised the pH of the top 5 cm of topsoil, however, the sandy soil below this depth (5 – 15 cm) remained acidic. However, increasing the lime rate to 3 t/ha raised the soil pH in the subsoil layer to above the critical level of 5.5. Ameliorating the soil with spading raised the pH of the top 15 cm of topsoil to above 6.5 in all soil layers. Spading mixed the soil to a depth of 25 cm, combining alkaline clay from the subsoil and with the sandy topsoil, thereby neutralising acidification. However, spreading lime before spading raised the pH to a level where the soil has started to become alkaline. The treatment that was deep ripped prior to spading has also made the soil alkaline with a pH of 7.5. This is due to the deep ripping process delving up clay which was then mixed through the topsoil with the spader.

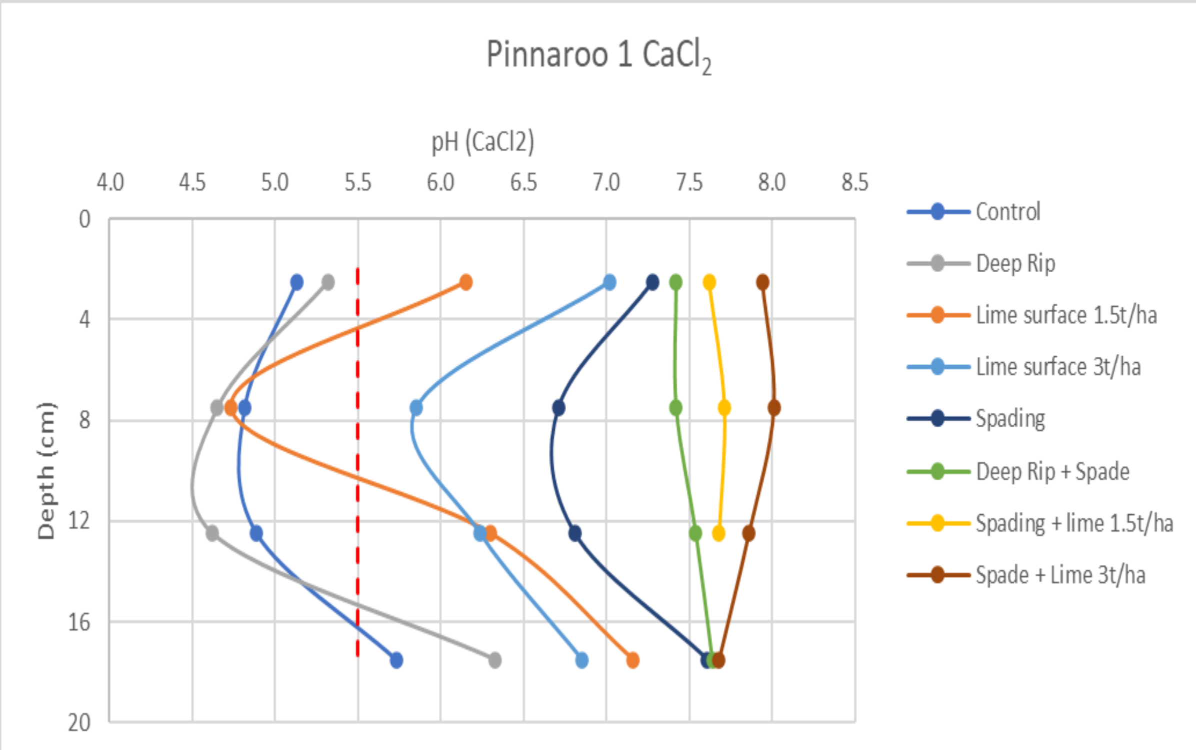

Figure 12. Effect of treatments on the pH ($CaCl_2$) of the sandy topsoil. Data curtesy of Brian Hughes, SARDI.

Due to the extremely dry seasonal conditions, lentil yields were very low, and the site was highly variable, therefore it was difficult to draw conclusions from the yield data (Figure 13). There were differences observed during the growing season; however, the plots were still very patchy. Figure 3 shows some of the observations of plants in the field with the controls exhibiting symptoms consistent with growing in acidic soil such as stumpy plants with poor root systems and a lack of nodulation. Conversely, plants growing in Spade + Lime @ 1.5 t/ha treatment were much healthier, both in terms of biomass, root development and nodulation. Consistent with the soil data, lentil growth was improved where 1.5 t/ha of lime was surface spread, however the root system and nodulation was still sub-optimal as subsurface acidification had not been overcome in this treatment.

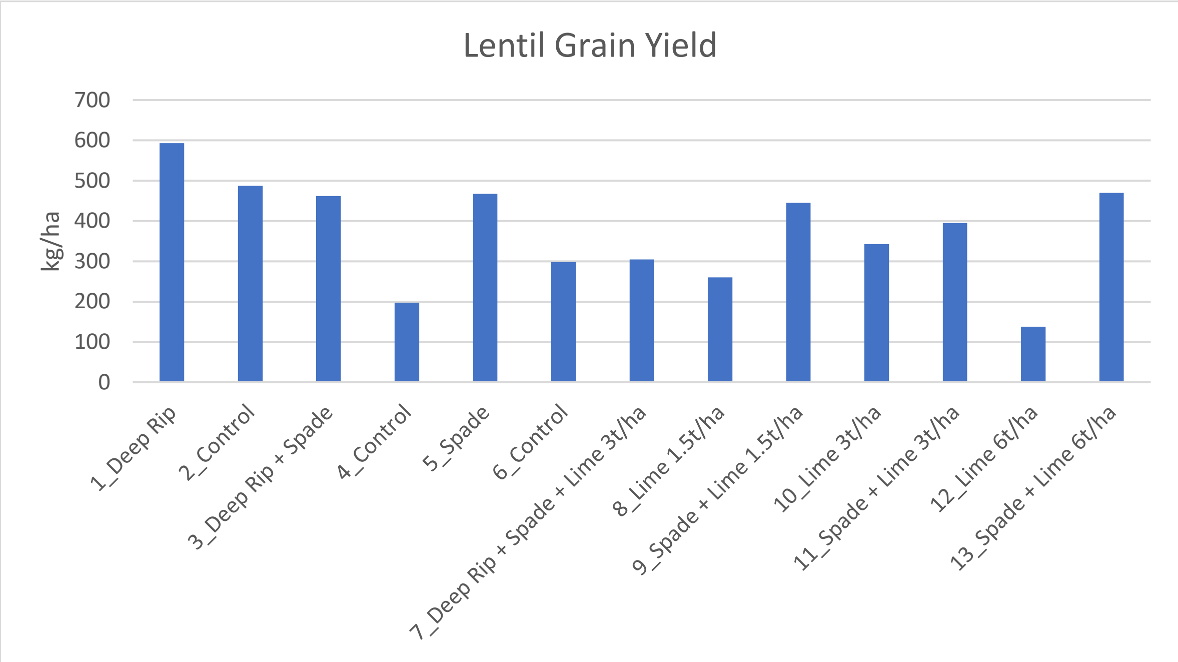

Figure 13. Grain yield of lentil produced for each treatment, Pinnaroo 2024.

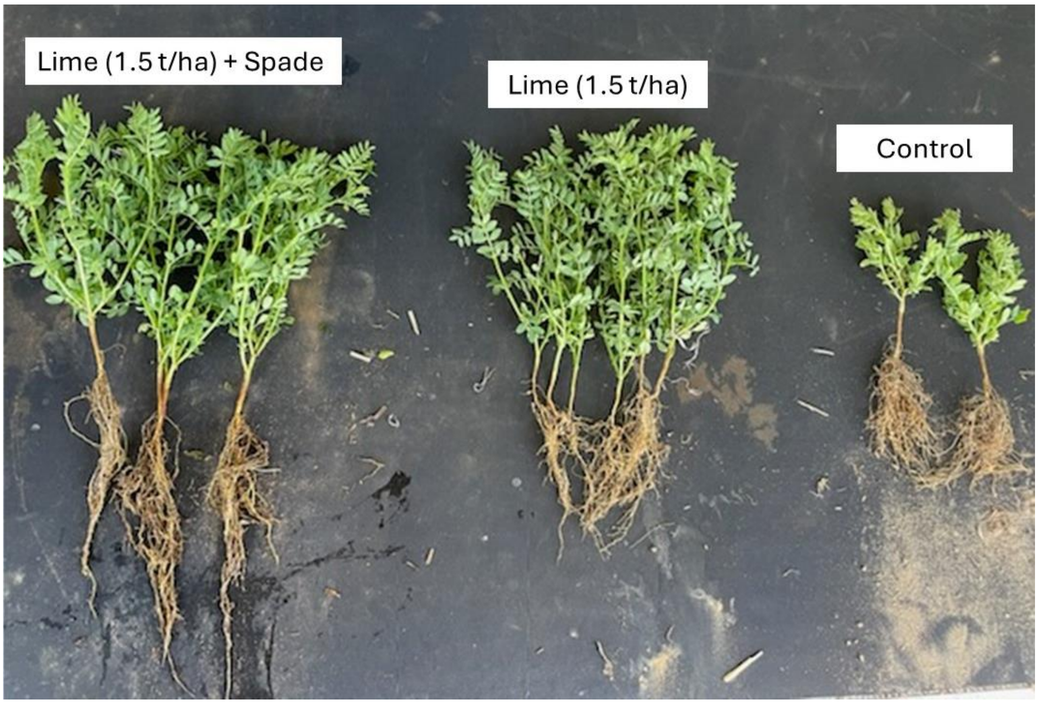

Figure 14. Lentil plants from the Spade + Lime @ 1.5 t/ha treatment (Left), Lime only @ 1.5 t/ha (middle) and control treatments (right).

Acknowledgements

Thank you to Wade and Chad Nickolls for hosting and assisting with the implementation of the demonstration

Thank you to Brian Hughes from SARDI for assistance monitoring the soil pH changes between treatments.

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