# SA Grain Legume
# Development and Extension Project
# UOA2105-013RTX


## 2022 Northern and Southern Mallee Field Trial Results

## Acknowledgements

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### Project Investment

Grains Research and Development Corporation: project UOA2105-013RTX Development and extension to close the economic yield gap and maximise faming systems benefits from grain legume production in South Australia

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**Cover image:** Hart Field Day Site pulse varieties demonstration, 20 September 2022.

## CONTENTS

## LAMEROO

### SITE SUMMARY

The Lameroo field trial site was situated on a brown-green, loamy clay loam soil. The soil was moderately alkaline with high levels of potassium and moderate to high salinity (Table 1).

Lameroo received similar rainfall to the long-term average in January, followed by no rainfall in February, above-average rainfall in March and below-average rainfall in April. Average rainfall in May and June provided adequate soil moisture for seed germination and even establishment across the site. Average rainfall in June, July and August slowed the development of foliar disease infection in lentil. However, above average spring rainfall combined with large crop canopies favoured the rapid development of botrytis grey mould in lentil. This foliar disease is favoured by mild temperatures and high humidity over an extended period, with conditions maintained with frequent rainfall events.

Overnight temperatures reached below zero degrees on two, three and one occasion in July, August and September, respectively (Figure 2). The lowest temperature recorded at -2.8°C occurred in July. High frequency of rainfall events in spring reduced the number of frost events occurring during reproductive growth stages.

Site average grain yield was 2.4 t/ha for lentil.

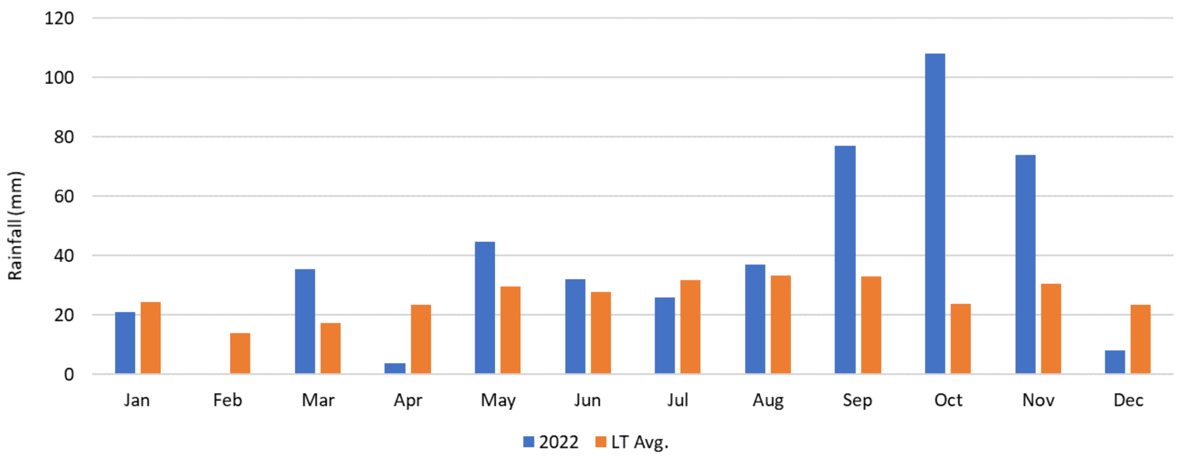



**Figure 1. Monthly rainfall recorded at the Lameroo field trial site in 2022 compared to the long-term average rainfall from the Lameroo (Austin Plains) BOM weather station (#25562).**

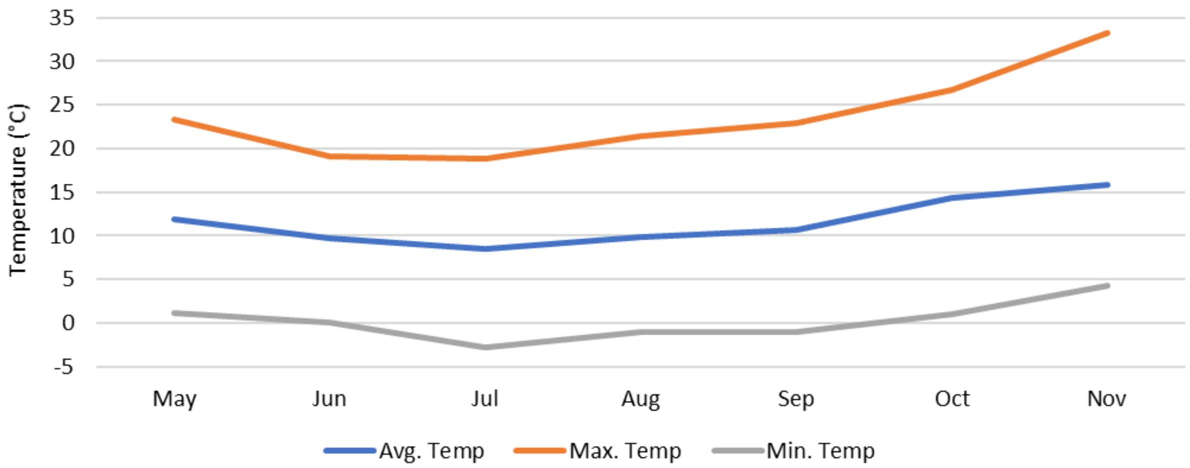



**Figure 2. Average, maximum and minimum temperature (°C) recorded during the growing season at the Lameroo field trial site in 2022.**

**Table 1. Soil profile characterisation (brown-green loamy clay soil) for the Lameroo field trial site, 2022.**

| 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** | 2 | 37 | 35 | 334 | 9.6 | 1.07 | 0.292 | 7.5 | 8.2 |
| **10-30** | <1 | 6 | 6 | 160 | 5.3 | 0.79 | 0.383 | 7.9 | 9.3 |
| **30-60** | <1 | 3 | 4 | 263 | 32.6 | 0.39 | 0.744 | 8.7 | 9.8 |
| **60-90** | 1 | 4 | 3 | 286 | 55.9 | 0.23 | 0.936 | 8.6 | 9.8 |
| **90-120** | 1 | 5 | <2 | 353 | 77.7 | 0.16 | 0.931 | 8.5 | 9.7 |

| Depth (cm) | Cu | Fe | Mn (mg/kg) | Zn | B | Exc Ca | Exc Mg | Exc K (meq/100g) | Exc Na | Exc Al |
|---|---|---|---|---|---|---|---|---|---|---|
| **0-10** | 0.45 | 18.4 | 5.88 | 1.80 | 2.83 | 10.85 | 3.40 | 0.79 | 1.00 | 0.03 |
| **10-30** | 0.70 | 29.9 | 1.63 | 0.24 | 7.18 | 16.95 | 9.27 | 0.51 | 3.41 | 0.04 |
| **30-60** | 1.18 | 18.5 | 1.04 | 0.33 | 23.25 | 8.51 | 10.96 | 0.64 | 7.44 | 0.04 |
| **60-90** | 0.96 | 15.5 | 0.83 | 0.09 | 36.89 | 5.69 | 9.98 | 0.81 | 9.19 | 0.03 |
| **90-120** | 0.70 | 13.5 | 0.53 | 0.08 | 43.16 | 3.63 | 9.38 | 0.85 | 10.04 | 0.03 |

## LENTIL VARIETY X DENSITY

*Sarah Day, Penny Roberts, **SARDI***

**Aim:** This trial aims to assess (1) lentil variety production performance in the low rainfall zone and (2) lentil production when sown at recommended and below recommended sowing densities.

**Methodology:**

Plots were harvested at crop maturity and grain yield was converted from kg/plot to t/ha. Data was analysed using ANOVA and fisher's least significant difference test in Genstat 21st Edition

**Treatments:**

*Varieties (BGM disease resistance rating):* PBA Jumbo2 (RMR), PBA Highland XT (MS), PBA Hallmark XT (MR), PBA Hurricane XT (MS), GIA Lightning (MS), CIPAL2122*

*CIPAL2122 is a pre-release experimental line developed as part of the GRDC investment in lentil breeding through Agriculture Victoria in Horsham.

*Sowing densities:* See Table 2.

**Table 2. Lentil target density (plants/m$^2$) and seeding rate (kg/ha) sown at Lameroo, 2022.**

| Seeding rate | Plants/m$^2$ | kg/ha* |
|---|---|---|
| **Recommended** | 120 | 50-70 |
| **Three-quarter** | 90 | 35-50 |
| **Half** | 60 | 25-35 |

*A range is given for seeding rate per hectare as this will vary depending on seed size and seed weight.

**Table 3. Agronomic trial details at Lameroo, 2022.**

| | |
|---|---|
| **Trial design** | RCBD |
| **Replicates** | 3 |
| **Sowing date** | 10/05/2022 |
| **Plant density** | As per treatments |
| **Row spacing** | 23 cm |
| **Fertiliser** | 80 kg/ha MAP + Zn |
| **Harvest date** | 07/12/2022 |

**Key messages**

- While herbicide tolerance characteristics are important to reducing yield loss from weed competition, the 2022 season is a reminder that it is important to also consider disease resistance when selecting varieties.

**Results and Discussion:**

Lentil response to variety was influenced by disease resistance and botrytis grey mould (BGM) infection at Lameroo in 2022. BGM is favoured by mild temperatures and high humidity. Spring conditions in 2022 were favourable for BGM infection in lentil and the disease was frequently reported and observed as aggressive in South Australia. BGM disease plot severity was recorded in October at Lameroo, with greater severity and reduced grain yield in those varieties with lower disease resistance (Figure 3).

Reducing the seeding density of lentil reduced the grain yield potential by at least 240 kg/ha at Lameroo, 2022 (Figure 4).

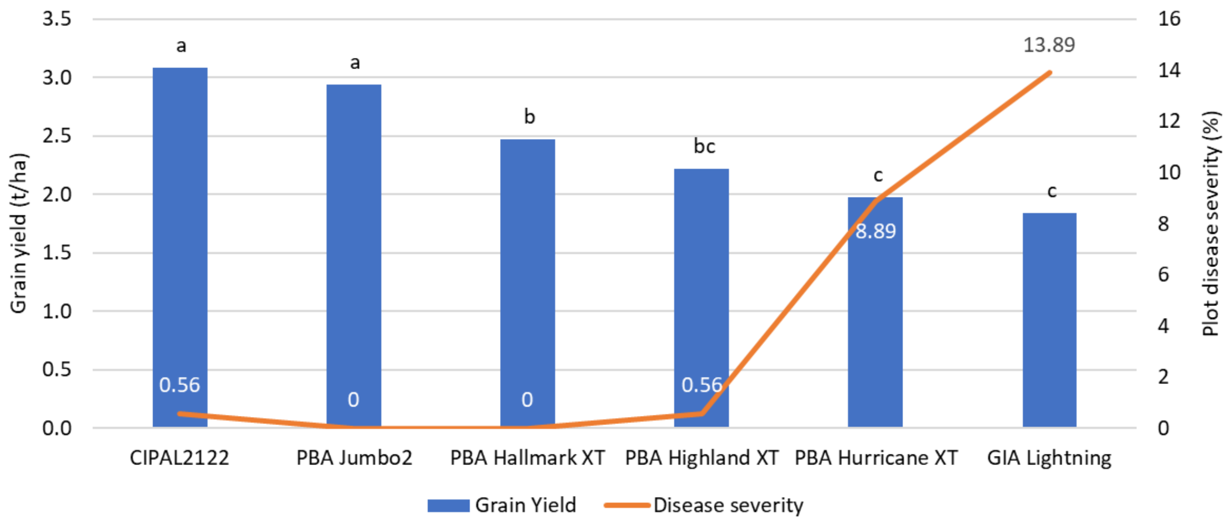



**Figure 3. Grain yield (t/ha) of lentil varieties was influenced by botrytis grey mould plot severity (percentage of plot infected) at Lameroo, 2022. Bars labelled with the same letters are not significantly different for grain yield (P<0.001, plot severity covariate P<0.001)**

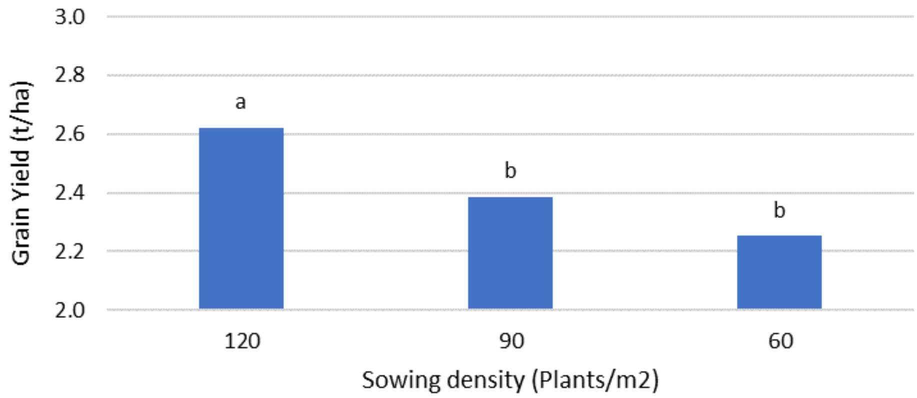



**Figure 4. Grain yield (t/ha) of lentil was reduced when sowing density was reduced at Lameroo in 2022. Bars labelled with the same letter are not significantly different (P=0.033).**

## LENTIL PRE-EMERGENT HERBICIDE USE

*Sarah Day, Penny Roberts, **SARDI***

**Aim:** to assess pre-emergent herbicide management to identify safe, efficient and economic options for use in lentil

**Methodology:**

Plots were harvested at crop maturity and grain yield was converted from kg/plot to t/ha. Data was analysed using ANOVA and fisher's least significant difference test in Genstat 21st Edition

**Treatments:**

*Variety:* PBA Hallmark XT

*Herbicide treatments:* See Table 4

**Table 4. Herbicide products, active ingredients and applications rates applied as treatments to PBA Hallmark XT at Lameroo, 2022.**

| Product | Active Ingredient | Herbicide rate (mL or g per ha) | |
|---|---|---|---|
| | | 1x rate | 2x rate |
| Metribuzin | 750 g/kg Metribuzin | 120 | 240 |
| Diuron | 900 g/kg Diuron | 400 | 800 |
| Terbyne® Xtreme® | 875 g/kg Terbuthylazine | 600 | 1200 |
| Reflex® | 240 g/L Fomesafen | 500 | 1000 |

**Table 5.Agronomic trial details at Lameroo, 2022.**

| | |
|---|---|
| **Trial design** | RCBD |
| **Replicates** | 3 |
| **Sowing date** | 10/05/2022 |
| **Plant density** | 120 plants/m$^2$ |
| **Row spacing** | 23 cm |
| **Fertiliser** | 80 kg/ha MAP + Zn |
| **Harvest date** | 07/12/2022 |

**Key messages:**

- Herbicide type, rate and application timing is important to reduce risk associated with lentil production, as lentils can be sensitive to herbicide use in dry conditions.
- Diuron was the lowest risk herbicide product applied to lentil at Lameroo in 2022.

**Results and Discussion:**

The 2022 season was characterised by a late break to the season and dry conditions leading up to seeding. Rainfall following herbicide applications on dry soil can results in the herbicide becoming mobile and causing crop damage. 7 mm of rainfall was received in the week post-sowing and post herbicide applications, causing early season herbicide damage, recorded as a percentage of plot damage, in PBA Hallmark XT lentil at Lameroo, 2022 (Figure 5). Herbicide applications incorporated by sowing (IBS) had the lowest levels of damage (< 20%), while herbicide applied at a 2x rate post-sowing pre-emergent (PSPE) had the highest herbicide damage. Metribuzin, a herbicide with high solubility, had greater herbicide damage at the PSPE 2x rate application with nearly 80% of the plot showing symptoms of herbicide damage. Diuron was the lowest risk product, with less than 2% plot damage across all applications (Figure 5).

Despite the early herbicide damage that occurred, this had no implications on the grain yield response (P=0.519). The average grain yield of PBA Hallmark XT lentil was 2.58 t/ha at Lameroo, 2022.

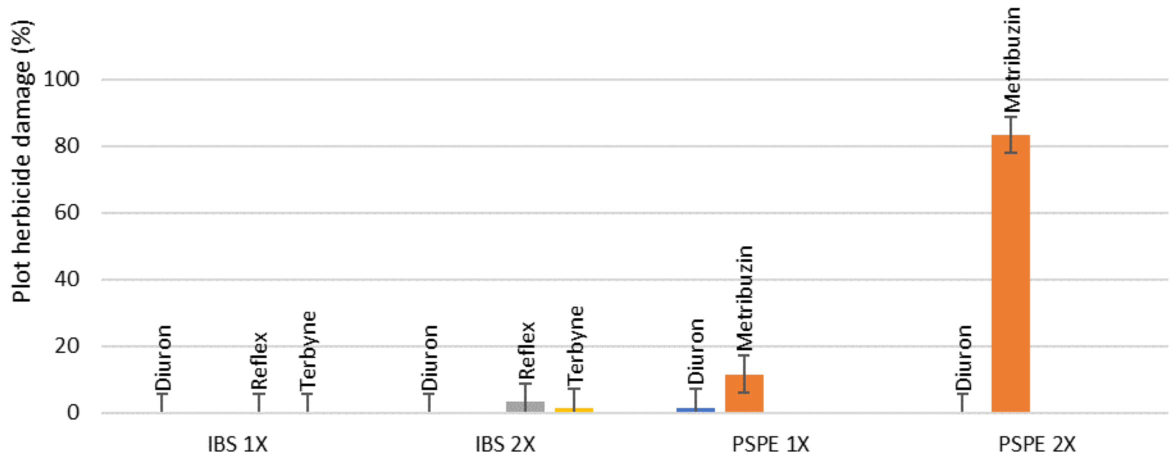



**Figure 5. Plot herbicide damage percentage (%) observed following the application of Group 5 herbicides applied at two different timings and two different rates, at Lameroo 2022. Error bars represent least significant difference (11.098, P<0.001).**

## PINNAROO

### SITE SUMMARY

A commercial scale demonstration site was established in a paddock approximately 10 km south-west of Pinnaroo. The soil type at the site has a 25 cm thick layer of sand overlaying a constrained clay subsoil (Figure 6). The sand layer (A horizon) has multiple constraints including:

- Mild water repellence
- Acidic in top 15cm from surface
- High penetration resistance
- Very low organic carbon and low nitrogen, sulphur and potassium fertility

The sodic clay B horizon is also hostile with high alkalinity, high soil strength, with toxic levels of boron and is saline.

| Depth cm | $pH_{Ca}$ | Avg PR | MinN | ColP | PBI | DGT P | Ex.K | S | B | Clay% | OC% | CEC | ESP | $EC_{1:5}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0-10 | 4.94 | 488 | 1.3 | 22 | 12 | 316 | 35 | <2.5 | 0.23 | 7 | 0.59 | 1.82 | 2.2 | 0.02 |
| 10-15 | 4.95 | 1658 | <1 | 22 | 12 | 347 | 38 | <2.5 | 0.14 | 8 | 0.26 | 1.54 | 3.3 | 0.02 |
| 15-25 | 5.88 | 2915 | 4 | 8 | 4 | 211 | 23 | <2.5 | 0.13 | 7 | 0.19 | 0.92 | 11.5 | 0.03 |
| 23-35 | 7.07 | 3117 | 5.1 | 5 | 40 | 24 | 279 | 2.5 | 2.40 | 19 | 0.18 | 12.2 | 15.1 | 0.11 |
| 35-55 | 8.48 | 3507 | 3.9 | <5 | 71 | 5 | 379 | 4.8 | 8.20 | 21 | 0.13 | 18.3 | 15.8 | 0.25 |
| 55-75 | 8.74 | 4753 | 4.6 | <5 | 92 | <4 | 532 | 11 | 18.0 | 32 | 0.12 | 36.7 | 14.4 | 0.44 |
| 75-100 | 8.6 | | 3.2 | <5 | 260 | <4 | 394 | 17 | 14.0 | 27 | 0.18 | 39.1 | 13.5 | 0.53 |
| 100-120 | 8.6 | | 2.4 | <5 | 114 | <4 | 417 | 17 | 15.0 | 33 | 0.13 | 39.2 | 15.4 | 0.53 |

**Figure 6. Summary of the soil properties at the Pinnaroo site.**

Summer rainfall in 2022 was drier than average, however cumulative rainfall was close to the long-term average during autumn and winter (Figure 7). A total of 260 mm of rainfall was received during spring, which was 166 mm more than the long-term average. This extraordinary rainfall induced agronomic issues such as waterlogging and high levels of foliar disease and consequently there was a high level of variability observed in crop growth across the site.

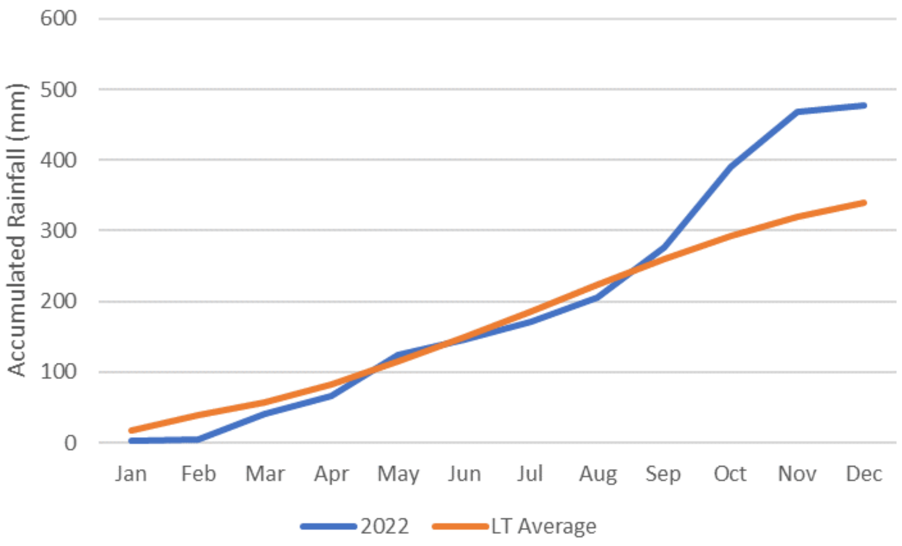



**Figure 7. Cumulative monthly rainfall for Pinnaroo in 2022 compared to the Long Term (LT) average.**

## INCREASED LENTIL PRODUCTION BY SOIL AMELIORATION ON MALLEE NON-WETTING SANDS (DEMONSTRATION)

**Authors:** Michael Moodie, Frontier Farming Systems

**Aim:** To improve lentil establishment, biomass production and grain yield by soil amelioration on non-wetting Mallee sands.

**Treatments**

Amelioration treatments aimed to alleviate soil constraints within the sandy A horizon. These included deep ripping, rotary spading, lime application (3 t/ha) and combinations of these. The deep ripping was implemented to a depth of 400 mm while the spading targeted a depth of 250 mm with the aim of staying above the hostile clay subsoil.

A secondary seeding systems treatment was overlayed across the site to compare seeding with conventional wide row tynes to narrow row disc seeding. The site was sown to PBA Highland XT lentils on the 28th of April 2022.

Treatments were established in large commercial scale plots (12 m x 40 m) (Figure 8). Treatments were not replicated, however control plots alternated between the treatment plots (Figure 8). As this was a commercial scale demonstration, data was not statistically analysed and caution is required when interpreting the data.

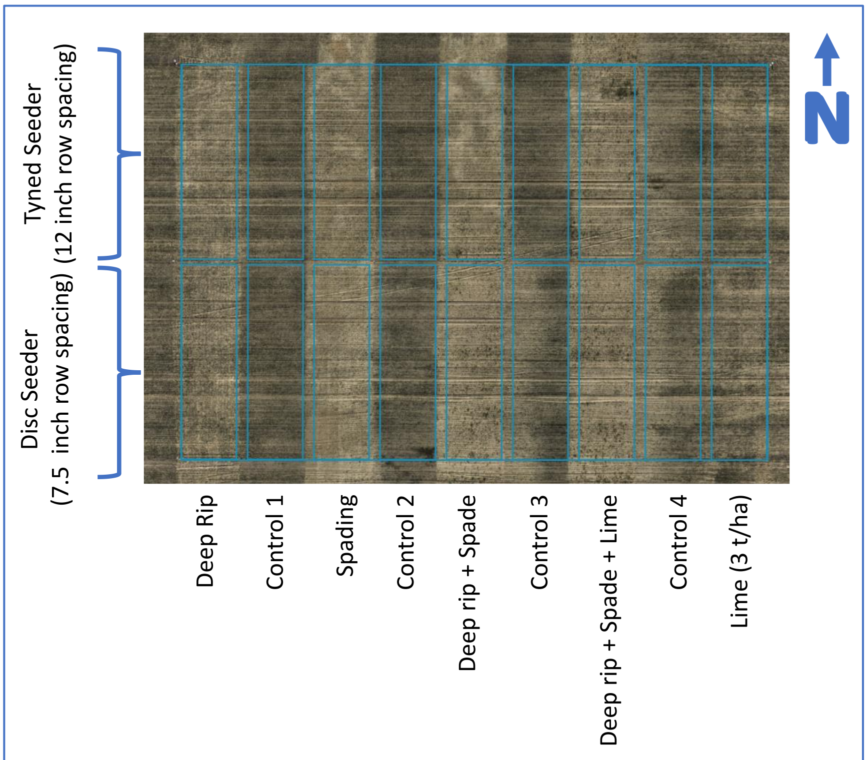



**Figure 8. Treatments and trial layout of the site. The size of each plot was 12 m wide and 40 m long.**

**Key messages**

- Sowing with a narrow disc system resulted in a 20% reduction in crop establishment relative to the wide row tyne seeding system.
- Spading reduced the early crop vigour through physical damage from sand blasting and phytotoxicity from pre-emergent herbicides.
- Despite early setbacks, grain yields from soil amelioration treatments were 0.5 t/ha higher than the control.
- There also appeared to be no yield penalty from sowing the crop with a narrow row disc seeder which may help to preserve existing stubble and help to maintain minimum groundcover levels on fragile sandy soils.

**Results and Discussion:**

Crop establishment was assessed on the 28th of June (Figure 9). There was a 20% reduction in crop establishment in disc seeding system (70 plants/$m^2$) relative to the tyne based seeding system (90 plants/$m^2$). There was no effect of soil amelioration with crop only varying by 10 plants/$m^2$ between these treatments.

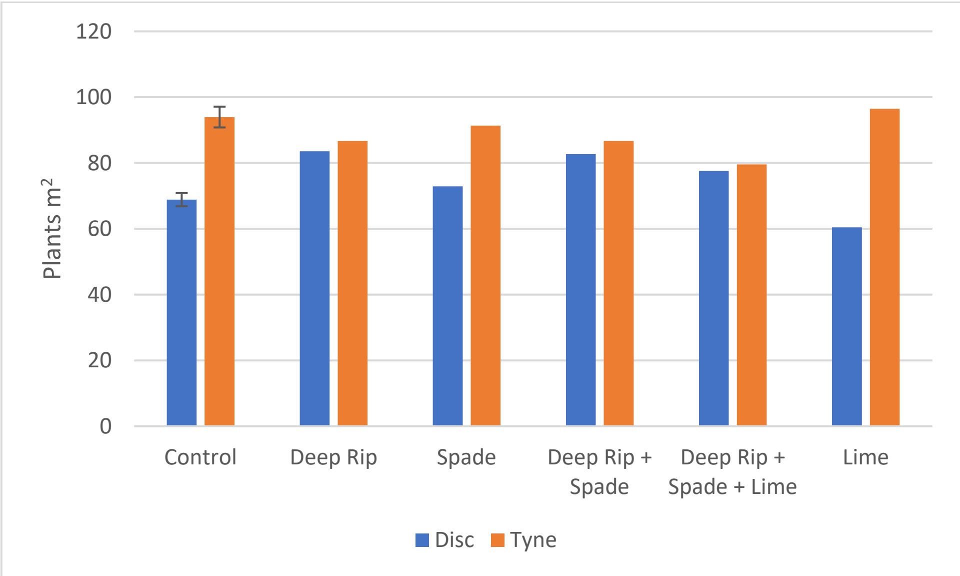



**Figure 9. Crop establishment assessed on the 29th of June 2022. The Standard Error of the alternating control treatments was 2 plants/$m^2$ for the disc seeder and 3.1 plants/$m^2$ for the tyne seeder (presented as an error bar on the control).**

A small plot harvester was used to measure yield by harvesting two 1.5 m wide strips from across each plot. All the amelioration treatments produced 0.5 t/ha grain yield benefit over the control with the standout treatment being spading without deep ripping (Figure 10). There was no measurable difference in the grain yield of the of the two seeding systems treatments of the wide row tyne and the narrow row disc seeder (data not shown).

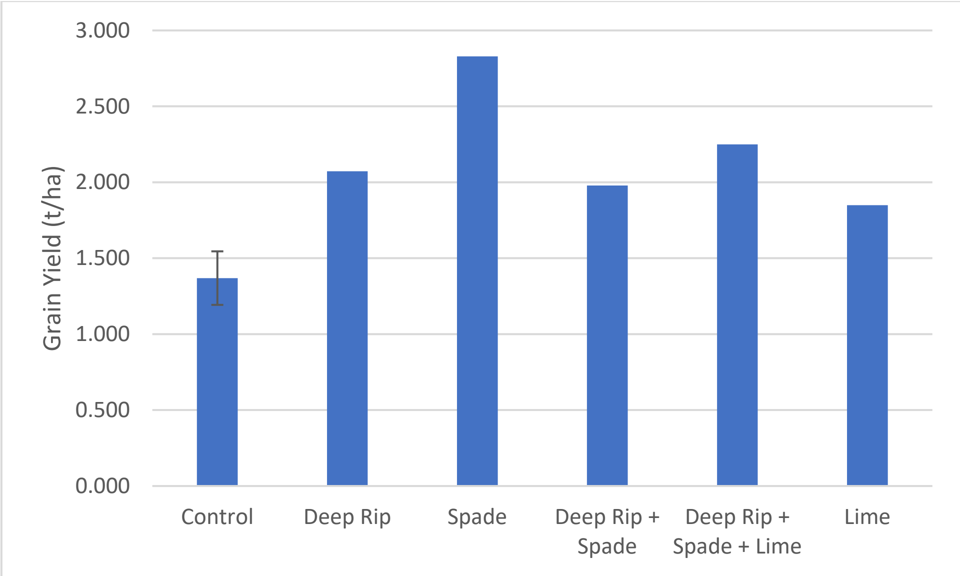



**Figure 10. Lentil grain yield (t/ha) averaged across soil amelioration treatments. The Standard Error of the alternating control treatments was 0.17 t/ha) (presented as an error bar on the control).**

## LOXTON

### SITE SUMMARY

Timely crop establishment was achieved with 78 mm falling during the critical April – May sowing window. The site experienced a relatively dry winter period with just 60 mm of rainfall recorded from June to August. Extremely high levels of rainfall were received during the spring with 290 mm of rain falling from September to early November with 200 mm of this received during October. Due to the sandy texture of the soil, waterlogging was not a problem, however, the growing season was extended three weeks longer than normal for lentil, while chickpea continued to grow and pod to about Christmas time.  There was no impact of abiotic stresses such as frost and heat, and foliar disease was managed with a robust fungicide program.  As a result, the grain yield of lentil and chickpea were up to 5 t/ha in the best performing treatments.

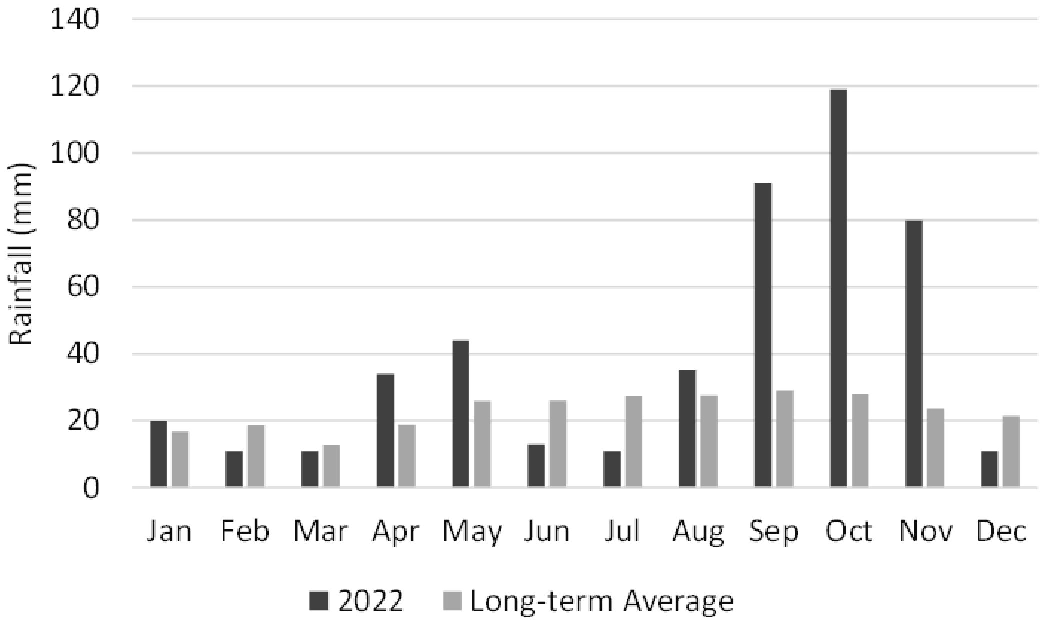



**Figure 11. Monthly rainfall recorded at the site in 2022 compared to the long-term average rainfall from the Loxton Research Weather Station (#024024).**

**Table 6. Loamy soil type characterisation at the Loxton trial site, 2022.**

| Depth (cm) | $NH_3$-N | $NO_3$-N | P (mg/kg) | K | S | OC (%) | EC (dS/m) | pH ($CaCl_2$) |
|---|---|---|---|---|---|---|---|---|
| **0-10** | 1.3 | 12 | 11 | 331 | 4.8 | 0.6 | 2.2 | 8.0 |
| **10-30** | <1 | 6 | | 368 | 5.7 | | 1.5 | 8.1 |
| **30-60** | <1 | 7 | | 319 | 8.3 | | 1.4 | 8.2 |
| **60-90** | <1 | 11 | | 418 | 7 | | 4 | 8.5 |
| **90-120** | <1 | 4.3 | | 514 | 8.6 | | 4.9 | 8.5 |

| Depth (cm) | Cu | Fe | Mn (mg/kg) | Zn | B | Exc Ca | Exc Mg (meq/100g) | Exc K | Exc Na |
|---|---|---|---|---|---|---|---|---|---|
| **0-10** | 0.17 | 3.5 | 3.2 | 1.1 | 0.6 | 82.5 | 9.9 | 7 | 0.6 |
| **10-30** | | | | | 2 | 87.5 | 8 | 4 | 0.5 |
| **30-60** | | | | | 2 | 76.1 | 18.1 | 2.5 | 3.4 |
| **60-90** | | | | | 12 | 62.8 | 19.6 | 3.3 | 14.3 |
| **90-120** | | | | | 21 | 63.4 | 13.8 | 3.7 | 19.1 |

**Table 7. Sandy soil type characterisation at the Loxton trial site, 2022.**

| Depth (cm) | $NH_3$-N | $NO_3$-N | P (mg/kg) | K | S | OC (%) | EC (dS/m) | pH ($CaCl_2$) | |
|---|---|---|---|---|---|---|---|---|---|
| **0-10** | <1 | 13 | 13 | 166 | 5.2 | 0.6 | 2.2 | 7.7 | |
| **10-30** | <1 | 6 | | 118 | 6.3 | | 2 | 8.2 | |
| **30-60** | <1 | 2.7 | | 88 | 3.7 | | 1 | 8.4 | |
| **60-90** | <1 | 2.7 | | 86 | 5 | | 1.7 | 8.5 | |
| **90-120** | <1 | 2 | | 164 | 4.1 | | 2 | 8.6 | |
| **Depth (cm)** | **Cu** | **Fe** | **Mn (mg/kg)** | **Zn** | **B** | **Exc Ca** | **Exc Mg (meq/100g)** | **Exc K** | **Exc Na** |
| **0-10** | 5.1 | 1.9 | 0.13 | 0.15 | 0.3 | 74 | 17.5 | 8 | 1 |
| **10-30** | | | | | 0.6 | 88 | 9 | 2 | 0.5 |
| **30-60** | | | | | 0.9 | 90 | 9 | 1 | 0.3 |
| **60-90** | | | | | 0.8 | 85 | 13.4 | 1 | 0.3 |
| **90-120** | | | | | 1.5 | 82 | 16.2 | 2 | 0.3 |

## NUTRITION X DEEP RIPPING IN LENTIL, CHICKPEA AND BARLEY

**Authors:** Michael Moodie, Frontier Farming Systems

**Aim:** To evaluate if grain yield responses to deep ripping and nutrition inputs on sandy soils are similar in pulse (lentil and chickpea) and cereals (barley).

**Methodology:**

Trial details are provided in Table 8. Biomass was measured with a quadrat cut (1 m x 6 rows) at were late pod/grain fill. Grain yield was measured using a plot harvester. Data was analysed using ASReml in R.

**Table 8. Agronomic trial details, Loxton 2022.**

| | |
|---|---|
| **Trial design** | Split plot |
| **Plot size** | 10 m x 1.68 m |
| **Replicates** | 3 |
| **Sowing date** | 5/5/22 |
| **Plant density** | Lentil: 120 plants/$m^2$; Chickpea: 35 plants/$m^2$; Barley: 120 plants/$m^2$ |
| **Row spacing** | 28 cm |
| **Fertiliser** | See Treatments |
| **Harvest date** | Lentil and Barley: 24/11/2022; Chickpea:10/01/2023 |

**Treatments:**

The trial compared nutritional treatments for lentil, chickpea and barley grown on contrasting Mallee soil types with and without deep ripping. There were 7 nutrient treatments (Table 9) applied to the following crops and varieties:

- Lentil: GIA Lightning
- Chickpea: Genesis 090
- Barley: Titan AX

Barley plots received 70 kg/ha UAN (~30 kg N/ha) applied in crop at early tillering.

All nutrient x crop treatments were applied to plots with and without deep ripping. The soil was ripped to a depth of approximately 50 cm using Tilco straight shank tynes.

The trial was replicated on two soil types within the paddock: A deep sandy soil located on the top of a dune, and a loam soil located in the swale between sandy dunes.

**Table 9. Nutrition treatments applied to lentil, chickpea and barley crops.**

<table>
<tr><th>Treatment No.</th><th>Treatment Description</th><th>Granular (Banded)</th><th>Liquid Inject (In furrow)</th><th>Liquid Foliar</th></tr>
<tr><td>1</td><td>Nil</td><td>Nil</td><td colspan="2" rowspan="4">Nil</td></tr>
<tr><td>2</td><td>MAP (Low)</td><td>MAP @ 25 kg/ha</td></tr>
<tr><td>3</td><td>MAP (High)</td><td>MAP @ 50 kg/ha</td></tr>
<tr><td>4</td><td>MAP (High) + SOA</td><td>MAP @ 50 kg/ha + SOA @ 50 kg/ha</td></tr>
<tr><td>5</td><td>MAP (High) + ZMC</td><td rowspan="2">MAP @ 50 kg/ha</td><td>Sipcam Multisol @ 8 L/ha</td><td>Sipcam Amino Boss ZMC @ 4 L/ha</td></tr>
<tr><td>6</td><td>MAP (High) + ZMC + Mo</td><td></td><td></td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| 7 | MAP (High) + SOA + ZMC + Mo | MAP @ 50 kg/ha + SOA @ 50 kg/ha | Sipcam Multisol @ 8 L/ha + Sipcam Amino Boss Moly @ 0.8 L/ha | Sipcam Amino Boss ZMC @ 4 L/ha + Sipcam Amino Boss Moly @ 0.8 L/ha |

** A further 70 L/ha UAN was applied foliar to barley plots only*

**Key messages**

- The grain yield benefit from deep ripping was 1.2 t/ha for all crops on the deep sandy soil. There was no benefit from deep ripping on the loam soil type.
- Lentil and barley crops were both responsive to the application of starter fertiliser with a grain yield gain of 15 kg grain per 1 kg of MAP applied.
- Chickpeas were un-responsive to all fertiliser treatments.

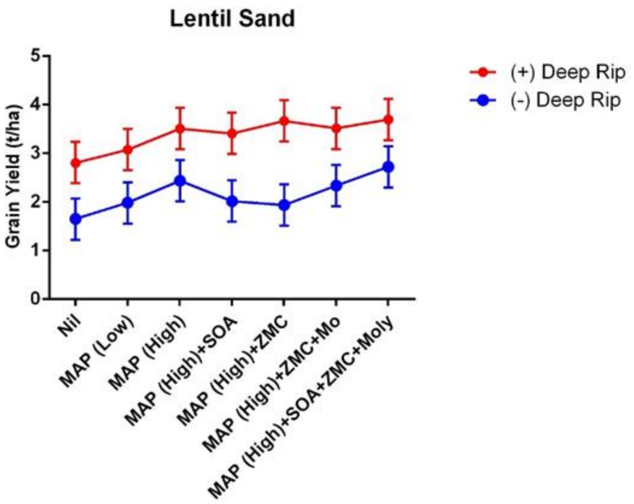
**Results and Discussion:**

Deep ripping had the biggest impact on the productivity of lentil, chickpea and barley grown on the sandy soil (Figure 12 to Figure 14). The benefit from deep ripping was consistent across all three crops with an extra 1.2 t/ha of grain grown following deep ripping. However, deep ripping was not beneficial in any crop on the loam soil.

There were some small benefits from nutrition treatments, however, these effects were mixed in terms of crop type and soil type. There was approximately 0.7 - 0.8 t/ha grain yield response from moving from applying 50 kg/ha MAP relative to the nil fertiliser treatment in lentils (Figure 12) and barley (Figure 13). The rate of response was similar across both soil types which equated to a rate of return of approximately 15 kg/grain for each one kilogram of MAP applied. In barley, the addition of sulphate of ammonia (SOA) also improved grain yield, but only on the sandy soil type (Figure 13).

The application of trace elements alone did not influence the productivity of any crop or soil type. However, when trace elements were applied in combination with SOA to barley on the un-ripped sandy soil, this combination produced superior grain yields to all other nutrition treatments (Figure 13). This complete nutrition package also closed the yield gap between ripped and un-ripped soil. However, given the extremely high growing season rainfall experienced at the site in 2022, it is probable that barley yields were nitrogen limited. Grain protein levels in barley were 10 – 10.5% which further indicates grain yields reached a nitrogen limited yield potential, which possibly capped the yield benefit achieved by deep ripping in barley.

Chickpeas were not responsive to any nutrition treatment on either soil type (Figure 14).



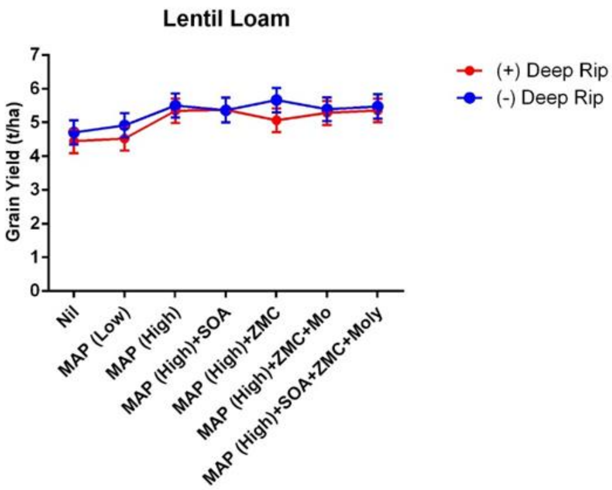



**Figure 12. Lentil grain yield response to deep ripping and nutrition inputs on the sandy soil type (left) and loamy soil type (right). Error bars represent the 95% confidence interval.**

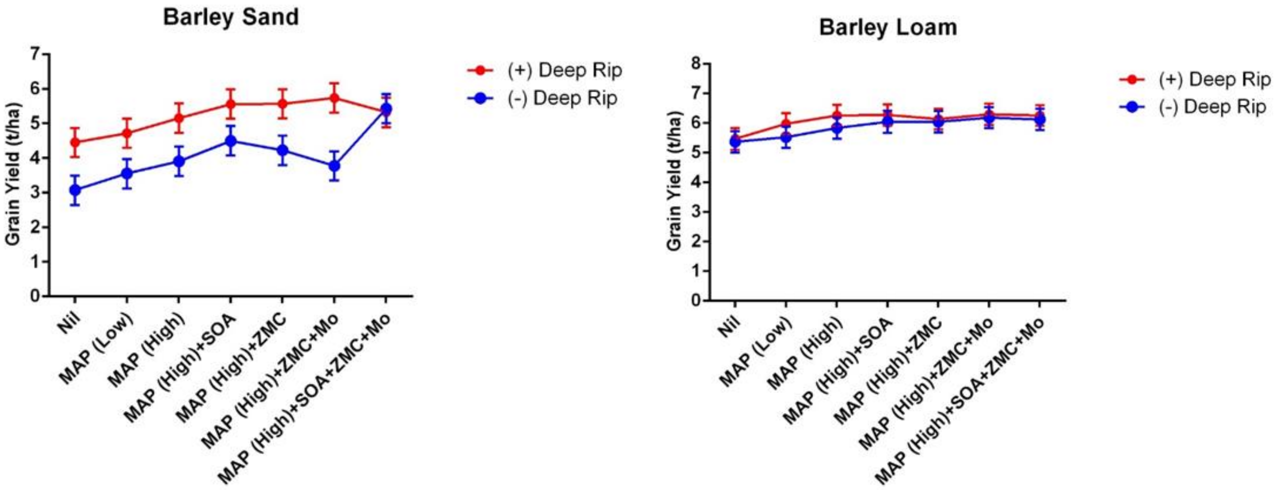



**Figure 13. Barley grain yield response to deep ripping and nutrition inputs on the sandy soil type (left) and loamy soil type (right). Error bars represent the 95% confidence interval.**

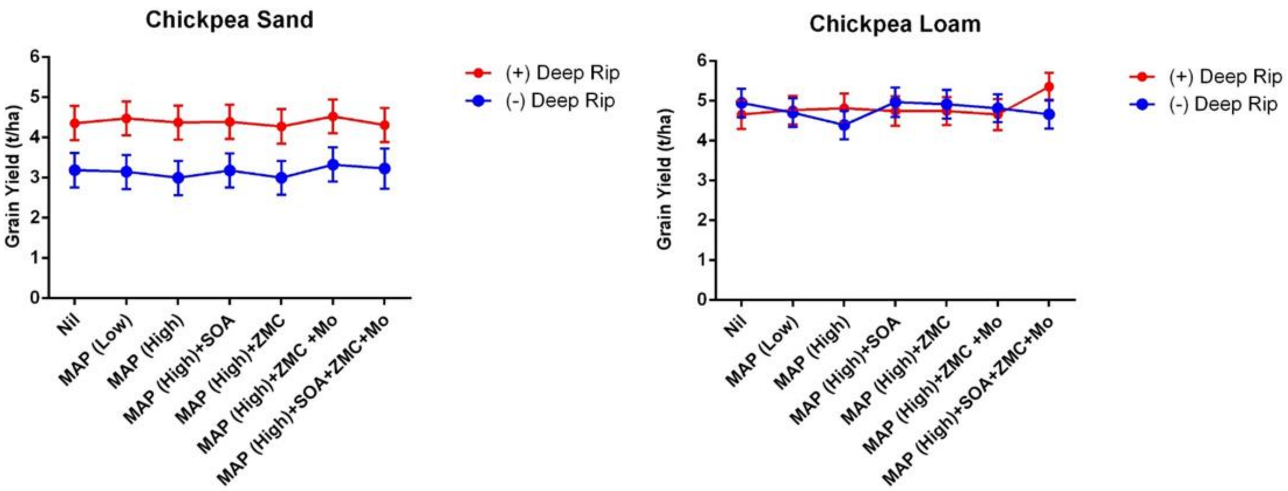



**Figure 14. Chickpea grain yield response to deep ripping and nutrition inputs on the sandy soil type (left) and loamy soil type (right). Error bars represent the 95% confidence interval.**

## IMPACT OF TIME OF SOWING AND SEEDING RATE ON THE YIELD AND HARVESTABILITY OF LENTIL VARIETIES

**Authors:** Michael Moodie, Frontier Farming Systems

**Aim:** To evaluate strategies to increase the productivity of harvestability of commercial lentil varieties grown in the low rainfall zone.

**Methodology:**

Trial details are provided in Table 10. Biomass was measured with a quadrat cut (1 m x 6 rows) at late pod/grain fill. Canopy height was measured at 3 locations in each plot immediately prior to harvest. Grain yield was measured using a plot harvester. Immediately following harvest a quadrat was placed in an undisturbed area of the plot that did not have trashed returned by the harvester. A photo taken of the quadrat and image analysis software was used to identify the dropped pods and shattered seeds visible in the photo. Data was analysed using a 2-way ANOVA in Genstat 22nd Edition.

**Table 10. Agronomic trial details, Loxton 2022.**

| | |
|---|---|
| **Trial design** | Split plot |
| **Plot size** | 10 m x 1.68 m |
| **Replicates** | 4 |
| **Sowing date** | 5/5/22 and 26/5/22 |
| **Row spacing** | 28 cm |
| **Fertiliser** | 50 kg/ha Granulock S Z |
| **Harvest date** | TOS 1: 24/11/2022; TOS 2: 5/12/2022 |

**Treatments:**

Six commercial lentil varieties were sown at Loxton in 2022 (Table 11). Each variety was sown at three seeding rates to target plant populations of 60, 90 plants and 120 plants $m^2$. Each treatment combination was sown at two Times of Sowing (TOS): $5^{th}$ May and the $26^{th}$ of May.

**Table 11. Sowing rates (kg/ha) used for each lentil variety to target plant densities of 60, 90 and 120 plants $m^2$. Individual rates were calculated using the 1000 grain weight for each variety and a field germination rate of 80%.**

| | | Target Plant Population | | |
|---|---|---|---|---|
| **Variety** | **1000 grain weight (g)** | **60 plants $m^2$** | **90 plants $m^2$** | **120 plants $m^2$** |
| PBA Hallmark XT | 44.4 | 32 | 48 | 64 |
| PBA Highland XT | 33.6 | 24 | 36 | 48 |
| PBA Hurricane XT | 39.6 | 29 | 43 | 57 |
| PBA Kelpie XT | 45.6 | 33 | 49 | 66 |
| GIA Lightning | 33.6 | 24 | 36 | 48 |
| GIA Thunder | 37.6 | 27 | 41 | 54 |

**Key messages**

- Sowing time had no impact on grain yield in 2022 due to the very wet and cool spring which extended the growing season of all varieties.
- GIA Thunder was the leading variety with an average grain yield of 4.2 t/ha
- Harvestability was excellent across all varieties with high biomass promoting tall canopies with minimal lodging. However, grain losses via pod drop and seed shattering were high with PBA Kelpie XT being the worst variety for grain loss.

**Results and Discussion:**

*Crop emergence*

The emerged plant population was 20-25% higher than the target population for all plant density treatments (Table 12). Seeding rates were calculated using a field germination rate of 80%, therefore most of the planted seeds emerged. This is mostly due to the excellent soil moisture present at both sowing times following 88 mm of rainfall falling in April-May. There was no difference (p=0.379) in emergence between varieties within each target plant population (data not shown). There was also no difference (p=0.637) in lentil emergence between the two sowing times (data not shown).

**Table 12. Number of emerged lentil plants for each target population treatment.**

| Target plants $m^2$ | Emerged plants $m^2$ |
|---|---|
| 60 | 76 |
| 90 | 112 |
| 120 | 143 |

*Grain Yield*

GIA Thunder was the highest yielding variety with an average yield of 4.2t/ha across all seeding rate and sowing time treatments (Figure 15). Grain yield of GIA Thunder was significantly higher than the other five varieties at TOS 1 and was superior to all varieties except GIA Lightning at TOS 2. PBA Kelpie XT had the lowest grain yield of all varieties at TOS 1, however, it produced similar grain yield to the other varieties, except GIA Thunder, at TOS 2 (Figure 15).

Time of sowing generally had no impact in lentil yield in 2022 at Loxton (p=0.684), due to the very wet and cool spring which extended the growing season. The target plant population did effect grain yield, but only at TOS 2 (Figure 16). Lentil grain yield increased linearly from 3.3 t/ha for 60 plants/$m^2$ to 3.9 t/ha for the 120 plants/$m^2$ treatment at TOS2.

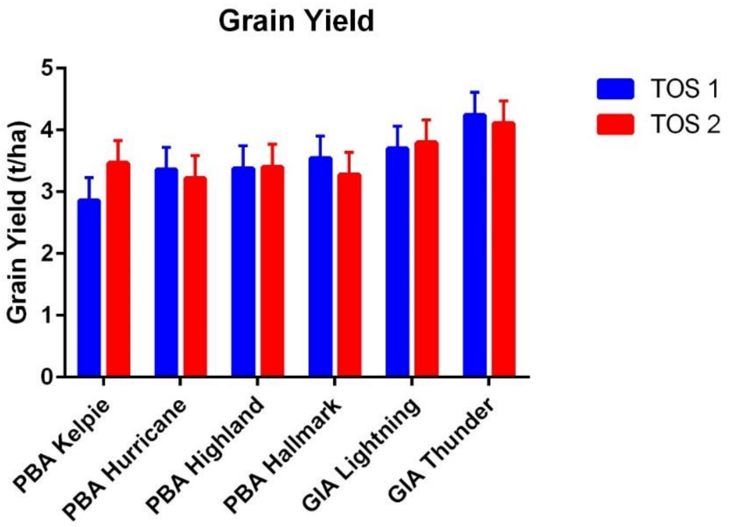



**Figure 15. Grain yield (t/ha) of lentil varieties sown at the two sowing times. Error bars represent the Least Significant Difference (p=0.05).**

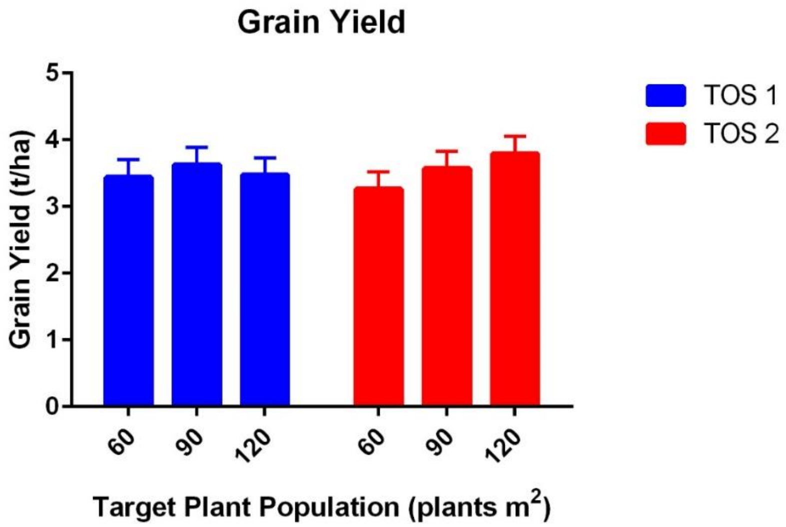



**Figure 16. Grain yield (t/ha) for each target plant population for each time of sowing. Error bars represent the Least Significant Difference (p=0.05).**

*Canopy Height*

Due to the exceptional biomass production, all treatments exhibited excellent harvestability with minimal lodging in any treatment. Plant height was measured prior to harvest with an average canopy height of 37.9 cm, which varied between treatments. Variety and time of sowing had the greatest impact on canopy height. PBA Highland XT sown at TOS 1 was taller than all other treatments, except for PBA Hallmark XT also sown at TOS 1 (Figure 17). Individually early sowing increased canopy height by 1.9 cm relative to the late sown treatments while the canopy of PBA Highland XT was on average at least 2.2 cm taller than all other varieties. The high seeding rate increased the overall canopy height by 0.79 cm ($p=0.045$) over the two lower seeding rate treatments (data not shown).

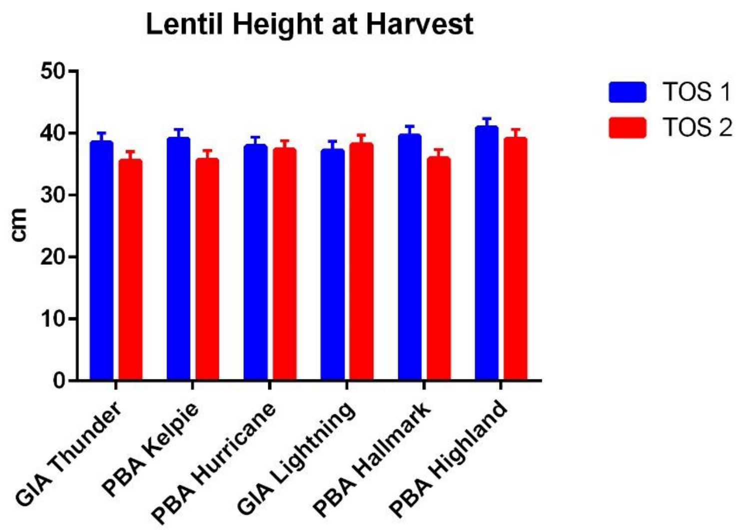



**Figure 17. Canopy height measured for each variety for each time of sowing. Error bars represent the Least Significant Difference (p<0.05)**

*Grain Losses*

Grain losses were greater with earlier sowing with 2.5 times more pods dropped and 3.2 times more seed shattered in the TOS 1 than in the TOS 2 treatments.  The greatest seed losses were measured in PBA Kelpie XT (Figure 23). Seed losses via pod drop were also higher in PBA Kelpie XT than in the other lentil varieties except for PBA Hallmark XT when sown at the early sowing date, however there was no difference between varieties for pod drop losses when sown at the second sowing time (Figure 24).  Seeding rate treatments had no significant impact on seed losses via seed shattering (p= 0.149) or pod drop (p= 0.629).

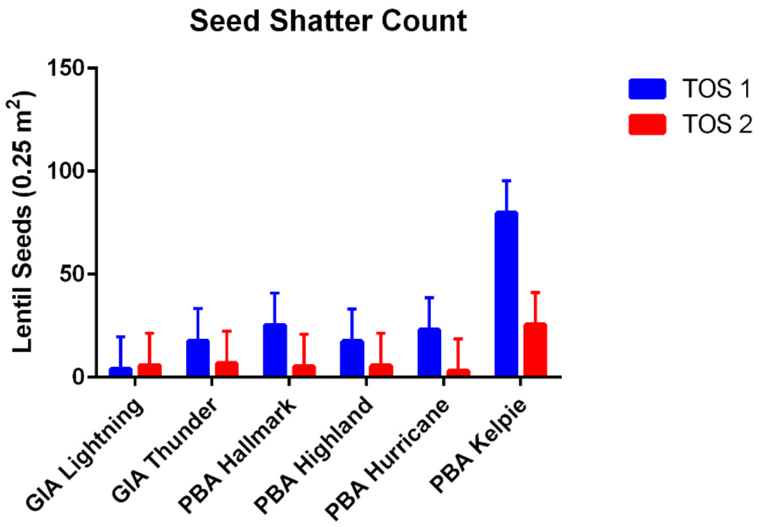



**Figure 18. Seed shattering measured for each variety. Error bars represent the Least Significant Difference (p<0.05).**

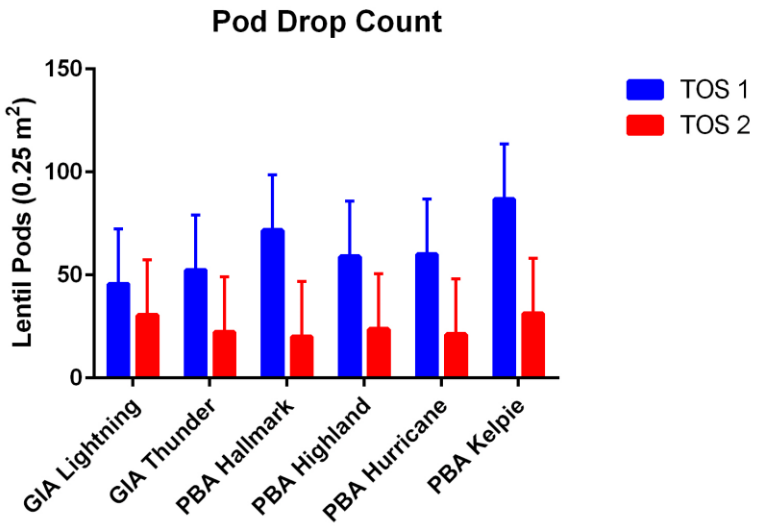



**Figure 19. Pod drop measured for each variety. Error bars represent the Least Significant Difference (p<0.05).**

## MANAGING ASCOCHYTA BLIGHT WITH VARIETAL RESISTANCE IN CHICKPEA

**Authors:** Michael Moodie

**Aim:** To quantify the benefit of improved varietal resistance to ascochyta blight in chickpeas grown in the low rainfall Mallee

**Methodology:**

Trial details are provided in Table 13. Ascochyta pod infection was scored prior to harvest using a 0-5 scale for the plot where 0 was no infection, 1 was minor infection and 5 was heavy infection. Grain yield was measured using a plot harvester. Data was analysed using a 2-way ANOVA in Genstat 22nd Edition.

**Treatments:**

The trial compared three chickpea varieties:

- CBA Captain (Desi)
- Genesis 090 (Kabuli)
- CBA Line (Desi)

CBA Captain and Genesis 090 are commercial verities. The Chickpea Breeding Australia (CBA) line is a non-commercial breeding line with improved resistance to ascochyta blight.

Each variety was grown with no fungicide applied (nil control) and regular fungicide applications to prevent the development of ascochyta blight (full control). The last fungicide application made to the full control treatment was in early October, however, due to the prolonged growing season, chickpea plots grew so large that further fungicide applications were not able to be applied to individual plots using a hand boom. As a result, a small amount of ascochyta blight affected the pods of the full control treatments.

**Table 13. Agronomic trial details, Loxton 2022.**

| | |
|---|---|
| **Trial design** | Split plot |
| **Plot size** | 10 m x 1.68 m |
| **Replicates** | 4 |
| **Sowing date** | 26/5/22 |
| **Plant density** | Chickpea: 35 plants/m$^2$ |
| **Row spacing** | 28 cm |
| **Fertiliser** | 50 kg/ha Granulock S Z |
| **Harvest date** | Chickpea: 10/01/2023 |

**Key messages**

- The grain yield of the commercial chickpea varieties Genesis 090 and CBA Captain was reduced by approximately 30% where ascochyta blight infection during pod fill was not treated with fungicides
- There was no significant difference in the grain yield of the CBA chickpea line with enhanced ascochyta blight tolerance where ascochyta blight infection during pod fill was untreated or treated with fungicides.

**Results and Discussion:**

All treatments were free of ascochyta blight up until the end of September, after which a combined total of 200 mm of rainfall fell in the months of October and November. These very wet conditions resulted in spore showers infecting mainly the pods of chickpea plants. Figure 20 shows that there were minor levels of disease on the full control treatments and high levels of disease in treatments where no fungicide was applied. The

CBA Line with improved ascochyta blight resistance had slightly less disease than the two commercial varieties (both currently rated moderately susceptible for ascochyta blight) with no disease control.

Ascochyta blight infection reduced the grain yield of both commercial lines, with a 1 t/ha grain yield difference between the nil and full control treatments of CBA Captain and Genesis 090 varieties (Figure 21). This represents 27 - 31% reduction in grain yield due to ascochyta blight infection of the pods. The improved disease resistance of the CBA line resulted in no statistically significant ($p<0.05$) yield penalty between nil and full control treatments.

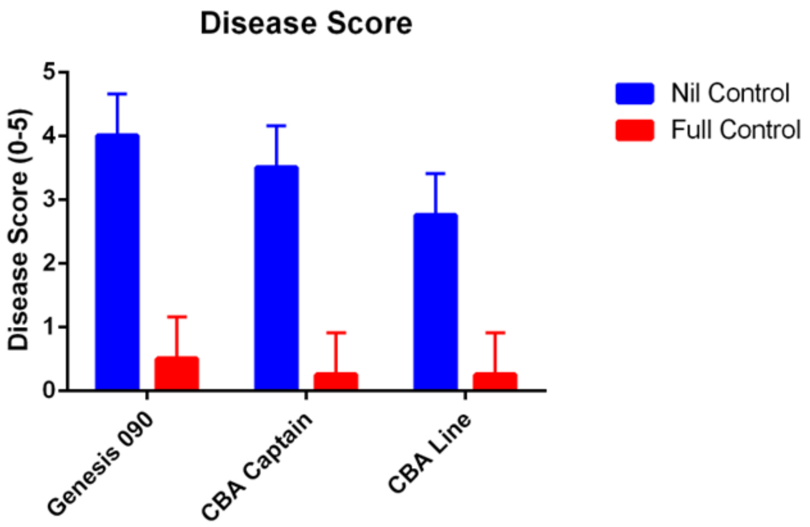



**Figure 20. Score (0-5) of the level ascochyta blight pod infection on chickpea treatments immediately prior to harvest, where 0 was no infection, 1 was minor infection and 5 was heavy infection. Error bars represent the Least Significant Difference (LSD) (p<0.05).**

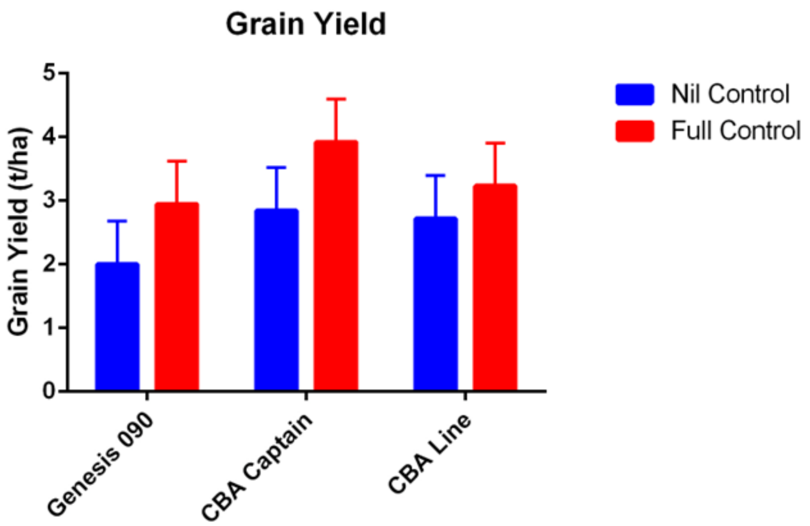



**Figure 21. Grain yield (t/ha) of chickpea varieties and disease control treatments. Error bars represent the Least Significant Difference (LSD) (p<0.05).**