# Kulpara, South Australia
# Medium Rainfall Zone, Northern Yorke Peninsula

No rainfall in March and April, followed by below average rainfall in May resulted in dry soil conditions at seeding. Close to average rainfall was received for June and July (Figure 1). This was followed by well below average rainfall for the remainder of winter and spring. Growing season (April – October) rainfall for 2024 was 165 mm compared to the long-term average of 289 mm. The 2024 annual rainfall was 198 mm, decile 1 (lowest 10% of rainfall records) compared to the 385 mm long-term average for Paskeville (closest BOM station).

During July through September there were four occasions where the temperature dropped below 0°C (Figure 2). The lentil trial would have been in vegetative growth stages in July and August and podding during the September 17th frost event (-1.7°C). Despite this there were no physical signs of frost damage. Spring temperatures were generally mild across the northern Yorke area (Figure 2).

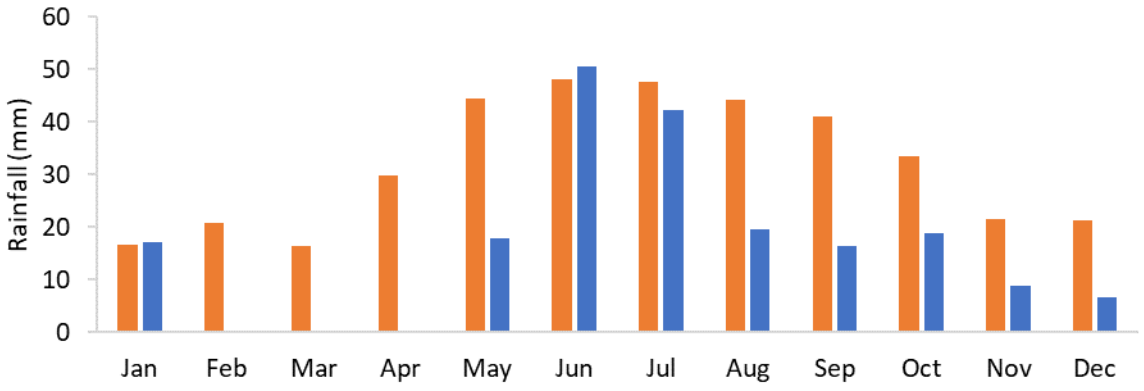


Figure 1. Monthly rainfall (recorded at Paskeville weather station (#022012) in 2024 (blue) compared to the long-term average (orange).



***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.*

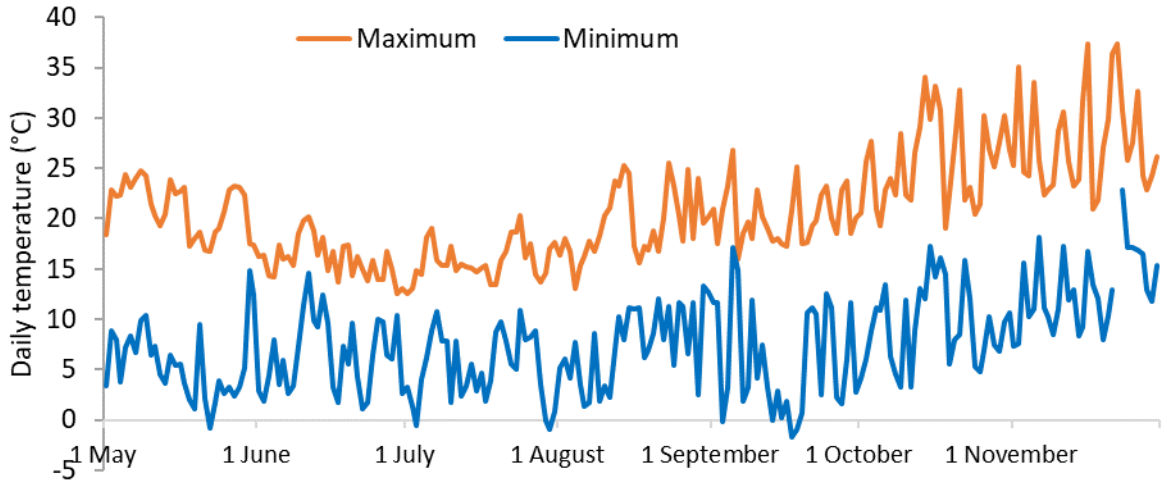


Figure 2. Daily minimum and maximum temperature (°C) recorded during the trial growing season at Kadina BOM station (#022050), 2024.

Table 1. Soil characterisation for Kulpara (0-10 cm) trial site, 2024.

| Depth | Texture | pH | pH | Organic Carbon | Colwell P | PBI | DGTP | Sulfur | |
|---|---|---|---|---|---|---|---|---|---|
| cm | | $CaCl_2$ | $H_2O$ | % | mg/kg | | ug/L | mg/kg | kg/ha |
| **0-10** | Loam | 7.7 | 8.2 | 1.96 | 26 | 96 | 25 | 30 | 39 |

| Depth | Conductivity | | Exchangeable Cations (CEC) | | | | | |
|---|---|---|---|---|---|---|---|---|
| cm | EC1:5 dS/m | ECe | Exc Al | Exc Ca % | Exc Mg % | Exc K % | Exc Na % | ECEC (cmol/kg) |
| 0-10 | 0.22 | 2.1 | <0.02 | 85.9 | 8.1 | 5.1 | 0.9 | 33.8 |

# Strategies for changing lentil canopy architecture to decrease pod loss

**Authors:** Stuart Sherriff, Sarah Noack, Sam Trengove, Jordan Bruce

**Aim:** To investigate strategies to alter the canopy structure through the selection of lentil variety, plant density and row spacing.

**Methodology:**

The trial was a split plot design consisting of 18 treatments (Table 2) with three replicates. The plots were 10 m long and were either 5 or 6 seeder rows wide depending on row spacing. Plots were sown using knife points and press wheels and all plots were rolled post emergent.

Measurements throughout the season included plant establishment counts (5th of July) and GreenSeeker NDVI (25th of July and 11th of September).

The trial was desiccated by the grower on the 13th of October when the surrounding paddock was sprayed. The trial was left for a month to increase exposure to pod drop events from the weather. Pod drop counts were conducted immediately prior to harvest. The method for pod drop loss included three counts at different locations in each plot for 0.5 m for two adjacent rows. All plots were harvested for grain yield on the 13th of November.

**Treatments:**

Table 2. Treatment descriptions including lentil variety, seeding rate and row spacing for the pod drop management trial at Kulpara in 2024.

| No. | Variety | Target density (plants/m$^2$) | Seeding rate (kg/ha) | Row spacing (mm) |
|---|---|---|---|---|
| 1 | **PBA Highland XT** Vigour: Mod/Good Flowering time: Early Maturity: Early/mid Pod drop: MR | 120 | 45 | 150 |
| 2 | | | | 250 |
| 3 | | | | 300 |
| 4 | | 180 | 68 | 150 |
| 5 | | | | 250 |
| 6 | | | | 300 |
| 7 | **GIA Thunder** Vigour: Moderate Flowering time: Mid Maturity: Mid Pod drop: MR | 120 | 59 | 150 |
| 8 | | | | 250 |
| 9 | | | | 300 |
| 10 | | 180 | 88 | 150 |
| 11 | | | | 250 |
| 12 | | | | 300 |
| 13 | **GIA2302L** Bushy Jumbo 2 plant growth type. | 120 | 64 | 150 |
| 14 | | | | 250 |
| 15 | | | | 300 |

| | | | | |
|---|---|---|---|---|
| 16 | Early flowering and maturing, similar to PBA Highland XT | 180 | 96 | 150 |
| 17 | | | | 250 |
| 18 | | | | 300 |

Table 3. Trial details for the lentil pod drop management trial at Kulpara, SA 2024.

| | |
|---|---|
| **Trial design** | RCBD |
| **Plot size** | 10 m x 5-6 rows depending on size |
| **Replicates** | 3 |
| **Sowing date** | 08/05/2024 |
| **Plant density** | Refer to Table 2 – 120 plant/$m^2$ or 180 plants/$m^2$ |
| **Row spacing** | Refer to Table 2 – 150 mm, 250 mm or 300 mm |
| **Fertiliser** | 100 kg/ha MAP + 1% Zn |
| **Harvest date** | 12/11/2024 |

**Key messages**

- Increasing the target plant density from 120 plants/$m^2$ to 180 plants/$m^2$ increased plant establishment and NDVI resulting in a more closed lentil canopy.
- Lentil pod drop across the trial was low (<63 kg/ha) due to no rainfall and minor wind events between desiccation and harvest.
- In general, lentil pod drop was proportional to grain yield. That is, higher yielding plots corresponded to higher levels of pod drop regardless of canopy management strategy.

**Results and Discussion:**

*Plant establishment*

The plant densities achieved in the trial were lower compared to the initial targets achieving between 81% and 93% establishment. On average 112 and 145 plants/$m^2$ were established for the standard and high rates, respectively (Table 4). Across the range of row spacings (150 – 300 mm) there was little variation in plant density ranging from 121 – 133 plants/$m^2$. The narrow row spacing was possibly lower due increased soil movement into adjacent rows, increasing seeding depth and potential for herbicide damage.

All three lentil varieties trialled achieved the same level of plant establishment across the range of treatments (data not shown).

Table 4. Plant establishment counts for target density (averaged across variety and row spacing) and for row spacing (averaged across variety and target density) in the pod drop management trial at Kulpara in 2024. Data labelled with the same letters within a column are not significantly different (P<0.05).

| Target density (plants/m$^2$) | Plant establishment (plants/m$^2$) | | Row spacing (mm) | Plant establishment (plants/m$^2$) |
|---|---|---|---|---|
| 120 | 112 a | | 150 | 121 a |
| 180 | 145 b | | 250 | 133 b |
| | | | 300 | 131 ab |
| Pr(>F) | <0.001 | | Pr(>F) | 0.016 |

*GreenSeeker NDVI*

In late July and mid-September GreenSeeker NDVI was assessed in all treatments. There were no differences in NDVI among the lentil varieties at either of these timings (data not shown). Based on their agronomic characteristics (Table 2) it was expected GIA2302L and PBA Highland XT would have higher early growth (biomass) and therefore a higher NDVI compared to GIA Thunder. However, given the well below average season rainfall the crop biomass for all varieties were similar.

As expected, increasing the target plant density from 120 plants/m$^2$ to 180 plants/m$^2$ increased NDVI at both timings (Table 5). The NDVI results also show row spacing of 250 mm and 300 mm generally had higher NDVI compared to the 150 mm row spacing (Table 5, Figure 3). This result can be attributed to plant establishment where lower plant establishment in the 150 mm spacing occurred and supports the theory that soil movement into adjacent rows at narrow row spacing likely resulted in herbicide damage reducing crop vigour.

Table 5. GreenSeeker NDVI for target plant densities and row spacing in the pod drop management trial Kulpara, 2024. Data labelled with the same letters within a column are not significantly different (P<0.05).

| Target density (plants/m$^2$) | NDVI July 25th | NDVI Sept 11th | | Row spacing (mm) | NDVI July 25th | NDVI Sept 11th |
|---|---|---|---|---|---|---|
| 120 | 0.164 a | 0.380 a | | 150 | 0.158 a | 0.371 a |
| 180 | 0.182 b | 0.403 b | | 250 | 0.181 b | 0.406 b |
| | | | | 300 | 0.182 b | 0.398 ab |
| | | | | | | |
| Pr(>F) | <0.001 | <0.001 | | | <0.001 | <0.001 |

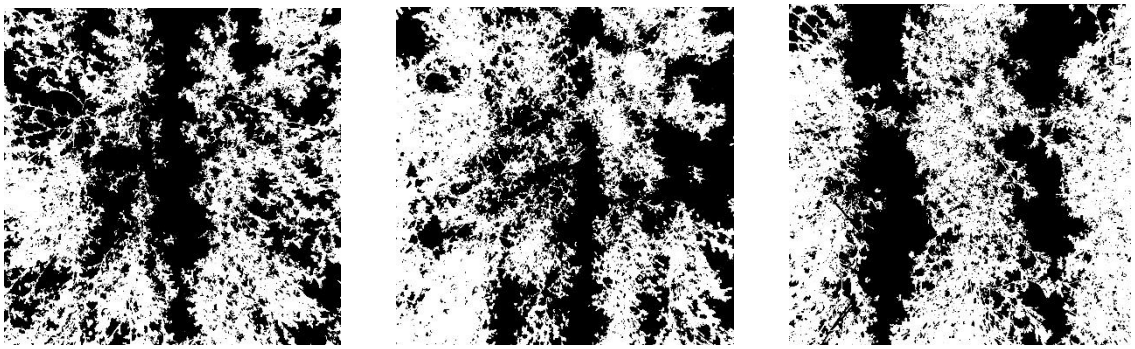

Figure 3. Canopeo images for PBA Highland XT 150 mm (46%), 250 mm (52%) and 300 mm (54%).

*Pod drop and grain yield*

The trial was harvested one month after desiccation to expose the lentil crop to weather events. During this period there was no rainfall or high wind speeds events. The amount of pod drop that occurred prior to harvest would be considered low in comparison to other seasons, ranging from 39 to 116 pods/$m^2$ (approximately 26 to 63 kg/ha, respectively).

While there was not a three-way interaction between variety, row spacing and seeding rate for pod drop there were individual and some two-way interactions. Among the lentil varieties, GIA2302L had the lowest pod loss followed by PBA Highland XT and GIA Thunder at 59, 78 and 101 pods/$m^2$ respectively (Table 6). As mentioned above, while there were minor differences in pod loss among the varieties in practical terms the overall pod drop was small (less than 63 kg/ha) for all treatments. GIA Thunder was the highest yielding variety averaging 1.26 t/ha compared to GIA2302L (1.06 t/ha) and PBA Highland XT (1.10 t/ha).

Grain yield was lowest for the narrow row spacing (1.07 t/ha) compared to the standard and wide averaging 1.18 t/ha. Pod loss was proportional to the grain yield (Figure 4) with the narrow row spacing having the lowest pod loss (Table 6). This season however, narrow row spacing has generally had a negative impact on lentil canopy architecture and resulting grain yield.

Table 6. Average pod drop and grain yield for the varieties and row spacings in pod drop management trial at Kulpara in 2024. ns = not significant. Data labelled with the same letters within a column are not significantly different (P<0.05).

| Variety | Spacing | Pod drop | | | Grain yield | |
|---|---|---|---|---|---|---|
| | | pods/$m^2$ | % of Highland 250 mm | estimated kg/ha* | t/ha | % of Highland 250 mm |
| GIA2302L | 150 | 39 | 37 | 26 | 1.01 a | 86 |
| | 250 | 62 | 59 | 41 | 1.10 abc | 94 |
| | 300 | 76 | 73 | 50 | 1.08 ab | 92 |
| PBA Highland XT | 150 | 46 | 44 | 28 | 0.96 a | 82 |
| | 250 | 105 | 100 | 63 | 1.17 bcd | 100 |
| | 300 | 84 | 79 | 50 | 1.16 bcd | 99 |
| GIA Thunder | 150 | 69 | 66 | 37 | 1.24 cd | 106 |
| | 250 | 118 | 112 | 63 | 1.27 d | 109 |
| | 300 | 116 | 110 | 61 | 1.28 d | 109 |
| | | | | | | |
| Pr(>F) | Variety | <0.001 | | | <0.001 | |
| | Row spacing | <0.001 | | | <0.001 | |
| | Variety x Row spacing | ns | | | 0.012 | |

*Estimated based on seed weight of 4.4 g/100 seeds for GIA2302L, 4.0 g/100 seeds for PBA Highland XT and 3.5 g/100 seeds for GIA Thunder and an assumed 1.5 seeds per pod.

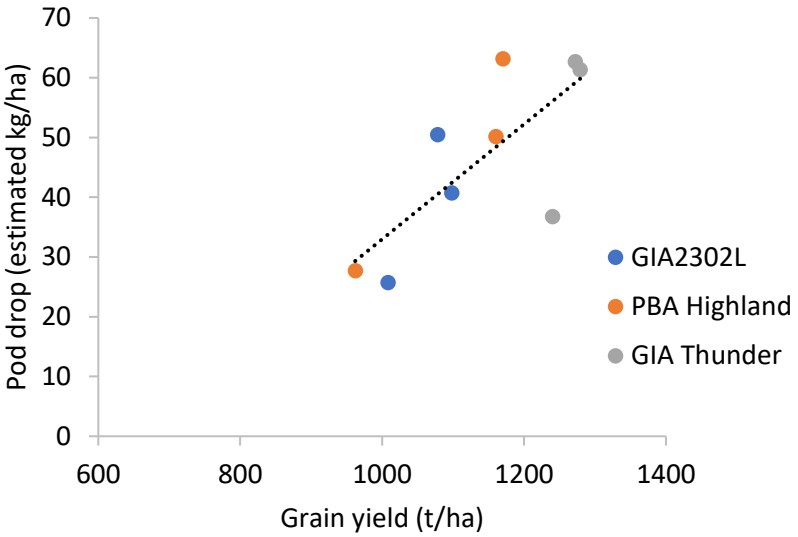


Figure 4. The relationship between grain yield and pod loss in the pod loss management trial at Kulpara, SA 2024 ($y = 0.0962x - 63.242$, $R^2 = 0.56$).

Increasing the target plant density from 120 plant/m$^2$ to 180 plants/m$^2$ resulted in a small increase in grain yield from 1.11 t/ha to 1.17 t/ha (Table 7). The relationship between grain yield and pod drop means that there was also a slight increase in pod drop as a result of increasing plant density. However, the net increase in yield negates any additional pod drop.

Table 7. Pod drop and grain yield for target plant densities in the lentil pod drop management trial at Kulpara SA, 2024.

| Target density (plants/m$^2$) | Pod drop (pods/m$^2$) | Estimated pod drop (kg/ha) | Grain yield (t/ha) |
|---|---|---|---|
| 120 | 71 | 43 a | 1.11 a |
| 180 | 87 | 52 b | 1.17 b |
| | | | |
| Pr(>F) | 0.004 | | <0.001 |

**Acknowledgements**

This research was funded by the GRDC as a part of project UOA2105-013RTX and is gratefully acknowledged. Trengove Consulting acknowledges the host grower for providing the site and assisting with trial management.