# Optimising Irrigated Grains (FAR1906-003RTX)

## A Grains Research & Development Corporation (GRDC) investment

# Winter Crops

## 2020 Provisional Research Results

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Trial Series Title **Winter Crops**

Trial Sites **Finley and Whitton, NSW**
**Kerang, Victoria**

Project Funder **GRDC**

Study Director **Nick Poole**

Research Organisations **Foundation for Arable Research Australia**
**Irrigated Cropping Council**

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# Results

Applicable to each of the yield tables are the following:
Yield figures followed by the same letter are not considered to be statistically different (p=0.05).
Plot yields: To compensate for edge effect a full row width (22.5cm) has been added to either side of the plot area (equal to plot centre to plot centre measurement in this case). All provisional results have been analysed through ARM software with further spatial statistical analysis when the final results are released.

## Water Use Efficiency (WUE)

Although it is open to different interpretations a standard water use efficiency has been worked out for the majority of trials based on dividing the yield (kg) by total water available (GSR + Irrigation) minus soil evaporation constant of 110mm. The result being the kg produced per mm of water available.

For the durum wheat trials at Finley WUE has been calculated more specifically using the final harvest dry matter (see page 61).



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# 2020 Winter Crop Provisional Results Summary

In 2020, 26 irrigated research trials were established at FAR Australia's Finley Irrigated Research Centre (Southern Growers Irrigation Complex) (GPS - 35.619083°, Longitude: 145.584803°) in southern NSW under the GRDC regional investment *"Optimising Irrigated Grains"* project. A further 22 trials were conducted by Irrigated Cropping Council (ICC) at the Kerang and Griffiths Irrigated Research Centres. The Finley research site is a collaboration between FAR Australia and Southern Growers, whilst the Griffiths Centre is a collaboration between ICC and the Irrigation Research and Extension Committee. With later harvest and spring crop trials the remaining eight trials in SE SA will be reported with the summer crop provisional results in August. The primary objective of these Irrigated Research Centre (IRC) was to look at all aspects of germplasm and input management to push the productivity boundaries for five irrigated crops (barley, faba beans, chickpeas, canola and durum wheat). At Finley the majority of trials were set up under overhead irrigation (travelling lateral) with a smaller number of identical trials set up on a flood irrigation system. At Kerang on the grey clay the reverse was the case. The Finley site was characterised by high fertility as a result of fallow in 2019 (cereal research only) and a failed faba bean crop affected by drought in 2018. Trials under overhead irrigation received a total of 125 or 150mm of irrigation (1.25- 1.5 Mega L/ha) applied as five or six applications of 25mm, whilst the flood irrigation bays received 240mm (2.4Mega L/ha) applied as three 80mm applications. This was in addition to a Growing Season Rainfall (GSR) of 244mm April – October. At Kerang, the fertility was relatively high as a result of brown manured dryland vetch in 2019. Trials that were conducted under flood were pre-irrigated or watered up in April, using approximately 150mm (1.5 Ml/ha) of irrigation. Spring irrigation application varied between trials, with most receiving 2 irrigations (approximately 180mm or 1.8 Ml/ha), with the chickpeas receiving a single irrigation (80mm) and the durums receiving 4 (280mm). Overhead irrigated trials received between 4 (108mm) and 8 (208mm) irrigations in the spring. Growing season rainfall (April – October) was 250mm, with April being a decile 10 start with 88.6mm for the month, which led into a dry winter until August and then a dry finish.

## *Finley, NSW*

### *Grain yields and harvest dry matter production under the two irrigation systems*

Though not statistically comparable, flood irrigation trials that received more water (484mm compared to 369mm) through the growing season were in general higher yielding than identical trials grown under an overhead irrigation system. Of the crops evaluated, all gave higher yields in identical plant population trials on the flood irrigation bays with canola yields peaking at 4.91t/ha (cv 45Y28), durum at 8.2t/ha (cv Vittaroi) and fabas at 7.45t/ha (cv PBA Amberley). Compared to peak yields under the overhead irrigation trials of 4.27t/ha with canola, 7.25t/ha with durum and 5.17t/ha with faba beans using the same cultivars.

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***Nutrition***

The research site was characterised by high levels of soil available nitrogen (N) at the start of the season with estimates of over 200kg N/ha at sowing on 0 – 90 cm following the fallow. This resulted in crops of canola and cereals being at their most profitable with lower and the lowest levels of applied nitrogen fertiliser. In addition to available soil mineral N at sowing there was evidence in durum of 70kg N/ha becoming available through mineralisation during the course of the season. High fertility and N mineralisation were mirrored in results observed with canola nutrition trials (following wheat stubble rather than fallow). Canola yields varied from 3.91 – 4.71t/ha based on 0 to 320kg N/ha applied with an optimum of 160kg N/ha. At harvest canola plots with no applied urea (N) fertiliser produced an N offtake of just over 140kg N/ha, harvest dry matter of 12.5t/ha and seed yield of 3.95t/ha. With the background fertility there were few significant differences in canola trials due to N timing.

***Crop structure and lodging***

Higher plant populations and associated problems with lodging was a constraint to yield observed in winter barley and durum wheat. The highest yields of durum wheat under a flood system were observed with a plant population of just less than 100 plants/$m^2$, despite a 19 May sowing date. Higher durum populations resulted in lower yields and higher levels of crop lodging, particularly in the flood irrigation trials. In barley a comparison of winter and spring germplasm showed that RGT Planet (spring) was higher yielding (mean 7.27t/ha in PGR trial) and less dependent on plant growth regulation than Cassiopée (winter) (mean 6.13t/ha). The fertility of the research site and earlier sowing (April 24) did not favour barley productivity and overall yields were disappointing, although lower fertility scenarios should produce better results.

In faba beans and canola experimental plant growth regulation treatments generated large reductions in canopy height and structure but produced no yield differences under overhead irrigation.

***Chickpea sowing date***

Under overhead irrigation two identical chickpea trials were set up to look at yield performance from an April and May sowing. The spatially separate trials are not statistically comparable however the population trial sown on 27 April gave an average yield of 3.32t/ha (with a peak yield 3.59t/ha cv Genesis090) compared to 19 May sowing with an average yield of 2.88t/ha (with a peak yield 3.41t/ha cv Genesis090). The optimum plant populations being approximately 30 plants/$m^2$ with the later sowing and approximately 20 plants/m2 with the earlier sowing. In both trials where plant population fell below the optimum at 10 plants/$m^2$, yields were reduced to 3.1t/ha and 2.39t/ha for early and late sowing.

***Disease Management***

Disease management was a key component to maximising yields on the Finley IRC site in chickpeas and durum. April sown chickpeas produced significant increases in seed yield from disease management strategies based on three fungicide applications. Although yields were higher with newer chemistry based on QoI (strobilurins) and SDHI chemistry the advantage over a chlorothalonil based strategy was not statistically significant. The highest yield achieved under full fungicide protection was 3.67t/ha (cv Genesis090). In canola good visual differences in branch blackleg infection



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did not result in large yield differences with the untreated, this was an unexpected result looking at at visual differences in treatments just prior to harvest.

***Soil Amelioration (in collaboration with NSW DPI)***

Following soil amelioration treatments being established by NSW DPI in March the trial area was sown with a commercial seed drill to faba beans on 19 May. The mixture of deep ripping, gypsum and organic amendment treatments produced significant yield increases of between 0.66 – 1.22t/ha over the untreated control but there were no significant yield differences amongst the soil amelioration treatments. Of the treatments it was noted that surface applied organic amendment (15t/ha Lucerne pellets) alone also produced a significant yield increase (0.66t/ha).

**Ben Morris and Tom Price – FAR Australia**

## *Kerang, Victoria and Whitton (Griffith), NSW*

***Grain yields and harvest dry matter production under the two irrigation systems***

Though not statistically comparable, flood irrigation trials that received more water (300 – 430mm compared to 108-280mm) through the growing season, and in general, produced higher biomass than identical trials grown under an overhead irrigation system. Of the crops evaluated, canola gave similar yields between the two systems, but flood irrigation resulted in higher yields in durum wheat and faba beans. Canola yields peaked at 4.1 t/ha (cv 45Y28), durum at 10.0 t/ha (cv Aurora) and fabas at 7.8 t/ha (cv PBA Amberley). Peak yields under the overhead irrigation trials were 4.3 t/ha in canola, 6.0 t /ha in durum and 4.6 t/ha in faba beans using the same cultivars.

***Nutrition***

The research site was characterised by high levels of soil available nitrogen (N) at the start of the season with estimates of over 160kg N/ha at sowing on 0 – 60 cm (ranging from 100 to 215 kg N/ha) following brown manures dryland vetch. This resulted in crops of canola and cereals reaching a yield plateau at the lower levels of applied nitrogen fertiliser.

Canola yields varied from 3.00 – 3.63 t/ha based on 0 to 320kg N/ha applied with an optimum of 80kg N/ha. Visually it was difficult to discern the various N rates or timings in the canola trial during the season. At early flowering, canola plots with no applied urea (N) fertiliser produced an N offtake of just over 250kg N/ha, harvest dry matter of 11.2 t/ha and seed yield of 3.00t/ha.

Similarly, the durum wheat plots that received no applied urea produced an N offtake of 174 kg N/ha, with a harvest dry matter of 14.5 t/ha and 7.8 t/ha of grain. In durum wheat, where grain protein of greater than 13% is a requirement to meet DR1 specifications, this was achieved by applying 200 kg N/ha on top of the soil N at sowing of 130 kg N/ha (0-60cm).

***Crop structure and lodging***



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Higher plant populations or higher rates of N, and associated problems with lodging, was a constraint to yield observed in faba beans and long season barley. Variety stem strength was also in play in the durum wheat trials.

The highest yield of durum wheat under a flood system were achieved with Aurora at 196 plants/m2, but that was not statistically different to all other sowing rates ranging from 72 – 240 plants/$m^2$. Lodging was controlled in Vittaroi with the single application of a PGR at GS31, whereas this was insufficient to prevent lodging in Aurora.

Where there was no control of lodging in Aurora, yield was reduced by 20% over the standard label rate and timing of Moddus Evo.

In faba bean experimental plant growth regulation treatments generated small reductions in canopy height and had limited effect on lodging at harvest. Lodging was influenced by seeding rates, where the lower rate of 12 plants/$m^2$ reduced lodging with no effect on yield. A late PGR application at the end of flowering saw reduced yields due to reduced seed size. In terms of target faba bean plant populations, the seeding rate trial saw yield plateau once a population of 17 plants/$m^2$ was reached, suggesting further research on target populations is required.

***Disease Management***

While disease management was a key part of the trials program, a dry winter and the few local crops saw little incidence of disease in the pulses. The disease strategies in chickpeas in both Griffith and Kerang saw no response, but a response to the 'expensive' strategy in Samira faba beans of 0.45 t/ha over the control despite little disease being visible.

Stripe rust was detected in the durum wheat trials, although the main infection period was before GS39, and so the flag leaf remained relatively unaffected. No treatment was significantly different to that of the untreated control.

***Soil Amelioration (in collaboration with NSW DPI)***

Following soil amelioration treatments being established by NSW DPI in March, the trial area was sown to a forage seed oat crop on 24 April. Initial response was to where the organic amendment had been applied, either to the surface or placed in the rip line, as increased crop biomass. These differences remained at flowering but by harvest, the mixture of deep ripping, gypsum and organic amendment treatments produced significant seed yield increases of between 0.9 – 1.4t/ha over the untreated control in all but one treatment where excessive lodging may have contributed to reduced yield.

**Damian Jones – Irrigated Cropping Council**

***Caution:*** *Please note that this provisional results summary has been produced prior to spatial analysis being carried out by SAGI. It is at this stage one-year results therefore please use caution in interpretating the results.*

Nick Poole – FAR Australia, Project Leader

25th February 2021



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Optimising Irrigated Grains

# Optimising Irrigated Grains (FAR1906-003RTX)

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## PROVISIONAL HARVEST RESULTS:

# Irrigated Faba Bean Trials

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# Finley Irrigated Research Centre NSW

*Irrigated trials conducted at the Finley irrigated research centre 2020 were managed by FAR Australia, hosted by Southern Growers.*

## Trial 1 Optimum Plant Population Under Overhead Irrigation

**Location:** Finley IRC
**FAR Code:** FAR F20-01-1
**Sown:** 28 April 2020
**Cultivar:** PBA Amberley and Fiesta VF
**Harvested:** 30th November 2020
**Rotation position:** Wheat (2019), Faba beans (2018), Fallow after Rice (2017)
**Soil type & Management:** Red clay, Cultivation with speed disc to incorporate stubble in Autumn
**Irrigation:** Overhead lateral irrigation 6 x 25mm in spring. Total applied 150mm (1.5 ML/ha)
**GSR:** April-October 244mm. Total water available (GSR + Irr) 394mm

**Key Messages:**

- *There was no significant difference in grain yield between Fiesta VF and PBA Amberley under overhead irrigation*
- *Seed rate had a significant impact on grain yield with yield maximised at plant populations of 16 plants/m$^2$ and above*
- *There was no significant difference in pod number between the plant populations although there was a trend suggesting lower pod numbers at populations of 10 plants/m$^2$.*
- *Plant population had a significant impact on crop height with a shorter crop at 10 plants/m$^2$.*
- *There was an interaction between cultivar and plant population on early dry matter production (8 node) where PBA Amberley maximised early dry matter production at 23 plants/m$^2$ and Fiesta VF maximised early dry matter production at 45 plants/m$^2$*
- *Plant population had an impact on dry matter production at early flowering with plant populations of 16/m$^2$ and above producing significantly more dry matter than 10-11 plants/m$^2$.*
- *Water use efficiency (WUE) for PBA Amberley based on 4.38t/ha was 15.4kg/mm.*

**Table 1.** Grain yield (t/ha) of four seed rates with two different cultivars grown under overhead irrigation.

| | | Yield t/ha | | |
|---|---|---|---|---|
| **Plants/m$^2$(actual)** | | **PBA Amberley** | **Fiesta VF** | **Mean** |
| **Amberley** | **Fiesta** | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** |
| 10 | 11 | 3.00 - | 3.31 - | **3.15 b** |
| 16 | 16 | 4.50 - | 4.93 - | **4.72 a** |
| 23 | 31 | 4.83 - | 4.84 - | **4.84 a** |
| 32 | 45 | 5.17 - | 5.15 - | **5.16 a** |
| **Mean** | | **4.38 -** | **4.56 -** | |

| | | | |
|---|---|---|---|
| **LSD Seed Rate p = 0.05** | 0.49 | **P val** | <0.001 |
| **LSD Cultivar p=0.05** | ns | **P val** | 0.343 |
| **LSD Seed Rate x Cultivar.** | ns | **P val** | 0.719 |

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**Table 2.** Influence of plant population and cultivar on canopy composition, plants/m$^2$ (GS13) and crop height (harvest) – assessed GS13 (2 June), harvest (25 Nov).

| | Plants population | | | Crop Height | | |
|---|---|---|---|---|---|---|
| **Seed Rate (seeds/m$^2$)** | **PBA Amberley** | **Fiesta VF** | **Mean** | **PBA Amberley** | **Fiesta VF** | **Mean** |
| | **Plants/m$^2$** | **Plants/m$^2$** | **Plants/m$^2$** | **cm** | **cm** | **cm** |
| **12 seeds/m$^2$** | 9.8 - | 10.5 - | **10.1 c** | 78 - | 77 - | **77 b** |
| **24 seeds/m$^2$** | 15.5 - | 16.0 - | **15.8 c** | 88 - | 97 - | **92 a** |
| **36 seeds/m$^2$** | 22.8 - | 31.0 - | **26.9 b** | 85 - | 92 - | **89 a** |
| **48 seeds/m$^2$** | 31.8 - | 45.0 - | **38.4 a** | 86 - | 93 - | **90 a** |
| **Mean** | **19.9 -** | **25.6 -** | | **84 -** | **90 -** | |
| **Cultivar LSD** | | 7.7 | | | 6.4 | |
| **P val** | | 0.099 | | | 0.069 | |
| **Seed Rate LSD** | | 9.2 | | | 5.4 | |
| **P val** | | <0.001 | | | <0.001 | |
| **Cultivar x Seed Rate LSD** | | ns | | | ns | |
| **P val** | | 0.415 | | | 0.300 | |

**Table 3.** Influence of plant population and cultivar on canopy composition, pods/m$^2$ (harvest) and height to first pod (harvest) – assessed harvest (25 Nov).

| **Treatment** | **Canopy composition** | |
|---|---|---|
| | **Pods/m$^2$** | **1st Pod Height (cm)** |
| **PBA Amberley** | | |
| 10 plants/m$^2$ | 261 - | 20.5 - |
| 16 plants/m$^2$ | 315 - | 21.4 - |
| 23 plants/m$^2$ | 359 - | 26.4 - |
| 32 plants/m$^2$ | 351 - | 23.2 - |
| **Fiesta VF** | | |
| 31 seeds/m$^2$ | 353 - | 26.7 - |
| **Mean** | **328** | **23.6** |
| **Cultivar x Seed Rate LSD** | 79 | ns |
| **P val** | 0.087 | 0.154 |

**Table 4.** Influence of plant population and cultivar on dry matter production (t/ha) at 8 node – assessed 7 July.

| | | **Dry Matter Production at 8 node** | | |
|---|---|---|---|---|
| **Plants/m$^2$** | | **PBA Amberley** | **Fiesta VF** | **Mean** |
| **Amberley** | **Fiesta** | **t/ha** | **t/ha** | **t/ha** |
| 10 | 11 | 0.19 d | 0.17 d | **0.18 c** |
| 16 | 16 | 0.25 cd | 0.35 bc | **0.30 b** |
| 23 | 31 | 0.31 bc | 0.41 b | **0.36 b** |
| 32 | 45 | 0.36 b | 0.57 a | **0.46 a** |
| **Mean** | | **0.28 -** | **0.38 -** | |

| | | | |
|---|---|---|---|
| **LSD Seed Rate p =** | 0.08 | **P val** | <0.001 |
| **LSD Cultivar** | 0.12 | **P val** | 0.077 |
| **LSD Seed Rate x** | 0.11 | **P val** | 0.040 |

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**Table 5.** Influence of plant population and cultivar on dry matter production (t/ha) at GS63 – assessed 31 August.

| | | Dry Matter Production at Early Flowering (GS63) | | |
|---|---|---|---|---|
| **Plants/m² (actual)** | | **PBA Amberley** | **Fiesta VF** | **Mean** |
| **Amberley** | **Fiesta** | **t/ha** | **t/ha** | **t/ha** |
| 10 | 11 | 1.02 - | 1.31 - | **1.16 b** |
| 16 | 16 | 1.73 - | 2.33 - | **2.03 a** |
| 23 | 31 | 1.88 - | 2.76 - | **2.32 a** |
| 32 | 45 | 2.23 - | 2.94 - | **2.59 a** |
| **Mean** | | **1.72 b** | **2.33 a** | |

| | | | |
|---|---|---|---|
| **LSD Seed Rate p = 0.05** | 0.67 | **P val** | 0.001 |
| **LSD Cultivar p=0.05** | 0.41 | **P val** | 0.018 |
| **LSD Seed Rate x Cultivar.** | ns | **P val** | 0.822 |

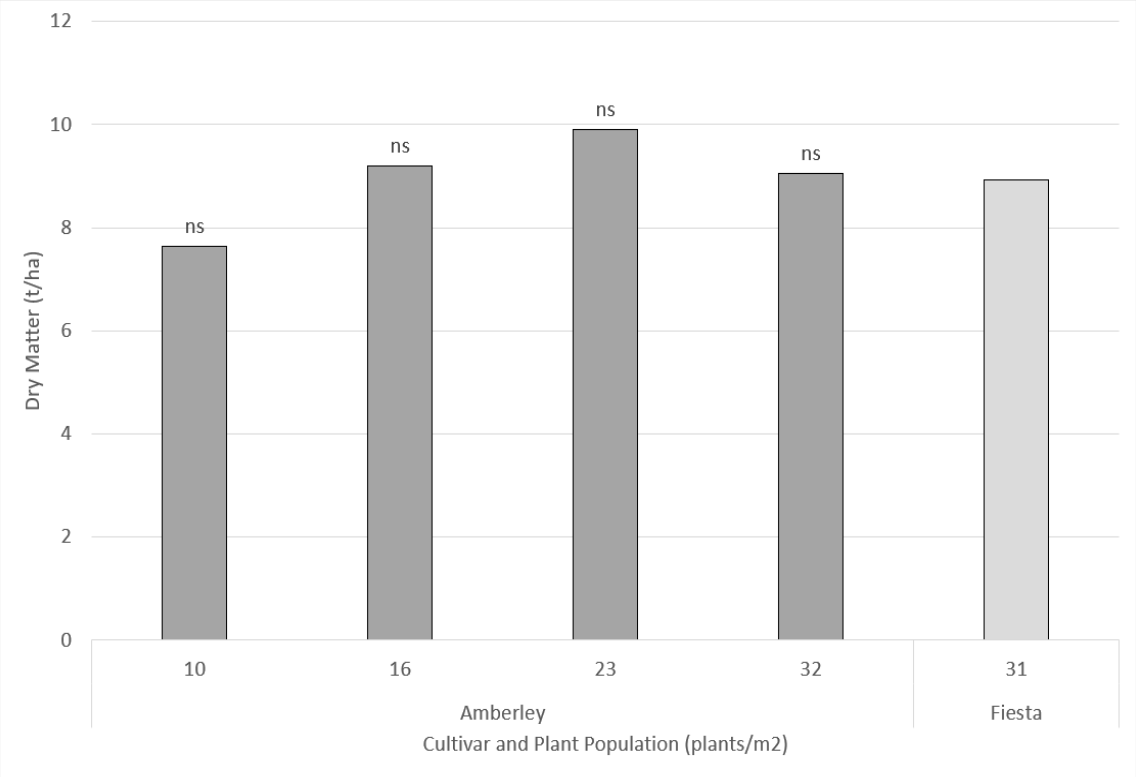


**Figure 1.** Influence of plant population on dry matter at harvest – assessed 25 November.



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## Trial 2 Optimum Plant Population Under Flood Irrigation

**Location:** Finley IRC
**FAR Code:** FAR F20-01-2
**Sown:** 28 April 2020
**Cultivar:** PBA Amberley and Fiesta VF
**Harvested:** 30th November 2020
**Rotation position:** Wheat (2019), Faba beans (2018), Wheat (2017)
**Soil Management:** Cultivation with speed disc to incorporate stubble in Autumn
**Irrigation:** Flood irrigation 3 x 80mm in spring. Total applied 240mm (2.4 ML/ha)
**GSR:** April-October 244mm. Total water available (GSR + Irr) 484mm

**Key Messages:**

- *Productivity exceeded 7t/ha with faba beans grown under flood irrigation and though not statistically comparable were 2t/ha higher yielding than the identical trial set up under overhead irrigation.*
- *Based on 90mm more water applied the faba beans grown on flood had higher pod numbers and greater harvest dry matter than their overhead irrigation equivalents.*
- *There was no significant difference (p=0.08) in grain yield between Fiesta VF and PBA Amberley under flood irrigation with an average yield of 6.71t/ha and 7.05t/ha respectively.*
- *Seed rate and resultant plant population had a significant impact on grain yield with yield maximised at populations of 23 plants/$m^2$ and above.*
- *There was no significant difference in pod number between the plant populations, indicating higher pod numbers per plant at the lowest populations.*
- *Plant population had an impact on early dry matter production (8 node) with plant populations of 20/$m^2$ and above producing significantly more dry matter than 11 – 13 plants/$m^2$.*
- *There was an interaction between cultivar, plant population and dry matter production at early flowering (GS 63) where PBA Amberley maximised dry matter production at lower populations (20 plants/$m^2$) than Fiesta VF which maximised dry matter production at 27 plants/$m^2$.*
- *Averaging grain yield and dry matter at harvest PBA Amberley had a harvest index of 45.4% (data not shown).*
- *The WUE for the higher yielding variety PBA Amberley (7.05t/ha) was 18.9kg/mm.*

**Table 1.** Grain yield (t/ha) of four seed rates with two different cultivars grown with flood irrigation.

| | | Cultivar | | |
|---|---|---|---|---|
| **Plants/$m^2$ (actual)** | | **PBA Amberley** | **Fiesta VF** | **Mean** |
| **Amberley** | **Fiesta** | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** |
| 11 | 13 | 6.28 - | 6.12 - | **6.20 b** |
| 20 | 25 | 7.45 - | 6.75 - | **7.10 a** |
| 31 | 27 | 7.33 - | 7.06 - | **7.19 a** |
| 26 | 31 | 7.15 - | 6.92 - | **7.04 a** |
| **Mean** | | **7.05 -** | **6.71 -** | |

| | | | |
|---|---|---|---|
| **LSD Seed Rate p = 0.05** | 0.35 | **P val** | <0.001 |
| **LSD Cultivar p=0.05** | 0.42 | **P val** | 0.083 |
| **LSD Seed Rate x Cultivar.** | ns | **P val** | 0.381 |

**Table 2.** Influence of seed rate and cultivar on plant population – assessed GS13 (5 June).



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| | Cultivar | | |
|---|---|---|---|
| | **PBA Amberley** | **Fiesta VF** | **Mean** |
| **Seed Rate** | **Plants/m²** | **Plants/m²** | **Plants/m²** |
| 12 seeds/m² | 11.1 - | 12.8 - | **11.9 c** |
| 24 seeds/m² | 20.0 - | 25.0 - | **22.5 b** |
| 36seeds/m² | 30.6 - | 26.7 - | **28.6 a** |
| 48 seeds/m² | 26.1 - | 31.1 - | **28.6 a** |
| **Mean** | **21.9 -** | **23.9 -** | |
| **Cultivar LSD** | ns | **P val** | 0.446 |
| **Seed Rate LSD** | 5.8 | **P val** | <0.001 |
| **Cultivar x Seed Rate LSD** | ns | **P val** | 0.354 |

**Table 3.** Influence of plant population and cultivar on canopy composition, pods/m² and height to first pod – assessed at harvest (26 Nov).

| **Treatment** | **Canopy composition** | |
|---|---|---|
| | **Pods/m²** | **1st Pod Height (cm)** |
| **PBA Amberley** | | |
| 12 seeds/m² | 451 - | 23.8 - |
| 24 seeds/m² | 453 - | 28.9 - |
| 36seeds/m² | 472 - | 27.9 - |
| 48 seeds/m² | 436 - | 32.6 - |
| **Fiesta VF** | | |
| 36seeds/m² | 557 - | 31.3 - |
| **Mean** | **474** | **28.9** |
| **Cultivar x Seed Rate LSD** | ns | ns |
| **P val** | 0.409 | 0.193 |

**Table 4.** Influence of plant population and cultivar on dry matter production (t/ha) at 8 node – assessed 7 July.

| | | **Dry Matter Production at 8 node** | | |
|---|---|---|---|---|
| **Plants/m² (actual)** | | **PBA Amberley** | **Fiesta VF** | **Mean** |
| **Amberley** | **Fiesta** | **t/ha** | **t/ha** | **t/ha** |
| 11 | 13 | 0.18 - | 0.25 - | **0.22 b** |
| 20 | 25 | 0.50 - | 0.45 - | **0.47 a** |
| 31 | 27 | 0.43 - | 0.56 - | **0.49 a** |
| 26 | 31 | 0.55 - | 0.55 - | **0.55 a** |
| **Mean** | | **0.41 -** | **0.45 -** | |

| | | | |
|---|---|---|---|
| **LSD Seed Rate p = 0.05** | 0.14 | **P val** | <0.001 |
| **LSD Cultivar p=0.05** | ns | **P val** | 0.266 |
| **LSD Seed Rate x Cultivar.** | ns | **P val** | 0.581 |

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**Table 5.** Influence of plant population and cultivar on dry matter production (t/ha) at GS63 – assessed 31 August.

| | | Dry Matter Production at early flowering (GS63) | | |
|---|---|---|---|---|
| **Plants/m² (actual)** | | **PBA Amberley** | **Fiesta VF** | **Mean** |
| **Amberley** | **Fiesta** | **t/ha** | **t/ha** | **t/ha** |
| 11 | 13 | 0.88 f | 0.99 ef | **0.93 c** |
| 20 | 25 | 1.83 bc | 1.36 de | **1.59 b** |
| 31 | 27 | 1.58 cd | 2.32 a | **1.95 a** |
| 26 | 31 | 1.65 bcd | 2.01 ab | **1.83 ab** |
| **Mean** | | **1.48 -** | **1.67 -** | |

| | | | |
|---|---|---|---|
| **LSD Seed Rate p = 0.05** | 0.30 | **P val** | <0.001 |
| **LSD Cultivar p=0.05** | ns | **P val** | 0.403 |
| **LSD Seed Rate x Cultivar.** | 0.41 | **P val** | 0.003 |

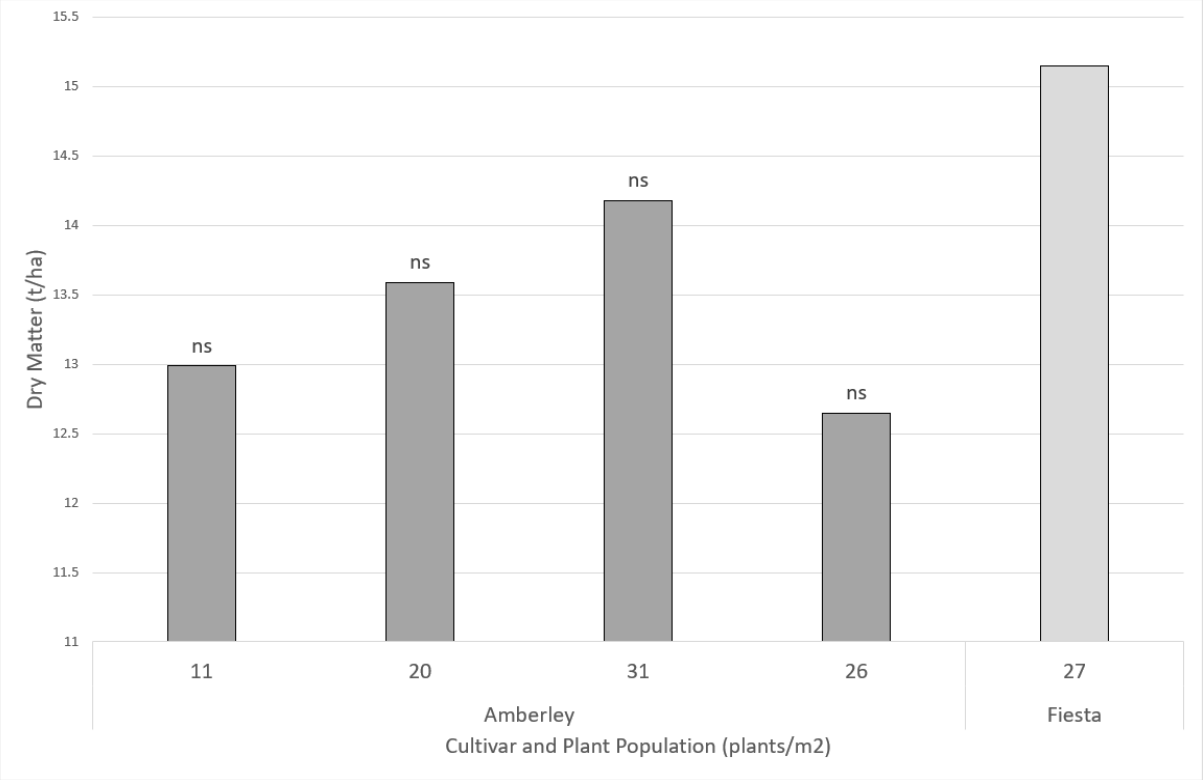


**Figure 1.** Influence of plant population on dry matter production (t/ha) at harvest – assessed 26 November**.**



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## Trial 3 Influence of Rhizobium Inoculation on the Break Crop Effect of Faba Bean Yield and Profitability

**Location:** Finley IRC
**FAR Code:** FAR F20-02-1
**Sown:** 28 April 2020
**Cultivar:** PBA Bendoc
**Harvested:** 30th November 2020
**Rotation position:** Wheat (2019), Faba beans (2018), Fallow after Rice (2017)
**Soil Management:** Cultivation with speed disc to incorporate stubble in Autumn
**Irrigation:** Overhead lateral irrigation 6 x 25mm in spring. Total applied 150mm (1.5 ML/ha)
**GSR:** April-October 244mm. Total water available (GSR + Irr) 394mm

**Key Messages:**

- There were no yield benefits of rhizobium inoculation or N input in irrigated faba beans on this research site.
- No benefit was observed in either dry matter, N uptake or root nodule score.
- The WUE based on a trial mean of 6.38t/ha was 22.5kg/mm.

**Table 1.** Influence of rhizobium inoculation on faba bean grain yield (t/ha) and protein (%).

| | | Grain yield and quality | |
|---|---|---|---|
| | | **Yield** | **Protein** |
| | **Treatment Rate & Timing** | **t/ha** | **%** |
| **1.** | Untreated | 6.35 - | 13.6 - |
| **2.** | Alosca 10kg/ha | 6.31 - | 13.4 - |
| **3.** | Alosca 20kg/ha | 6.38 - | 13.8 - |
| **4.** | Alosca 30kg/ha | 6.07 - | 13.3 - |
| **5.** | 40 kg N/ha pod set | 6.79 - | 14.1 - |
| **6.** | 40 kg N/ha IBS | 6.35 - | 13.6 - |
| | **Mean** | **6.38** | **13.6** |
| | **LSD** | ns | ns |
| | **P val** | 0.412 | 0.336 |

**Table 2.** Influence of rhizobium inoculation on faba bean dry matter production and nitrogen uptake at mid flowering and harvest – assessed GS64 (11 Sep) and harvest (25 Nov).

| | | Mid flowering (GS64) | | Harvest |
|---|---|---|---|---|
| | | **Dry matter** | **Nitrogen (N)** | **Dry matter** |
| | **Treatment Rate & Timing** | **t/ha** | **Kg/ha** | **Kg/ha** |
| **1.** | Untreated | 5.31 - | 202 a | 12.93 - |
| **2.** | Alosca 10kg/ha | 5.46 - | 153 bc | 10.57 - |
| **3.** | Alosca 20kg/ha | 4.40 - | 152 bc | 11.62 - |
| **4.** | Alosca 30kg/ha | 5.13 - | 183 ab | 12.74 - |
| **5.** | 40 kg N/ha pod set | 4.15 - | 139 c | 9.99 - |
| **6.** | 40 kg N/ha IBS | 5.33 - | 201 a | 14.17 - |
| | **Mean** | **4.96** | **172** | **12.00** |
| | **LSD** | ns | 38 | 3.10 |
| | **P val** | 0.198 | 0.011 | 0.093 |



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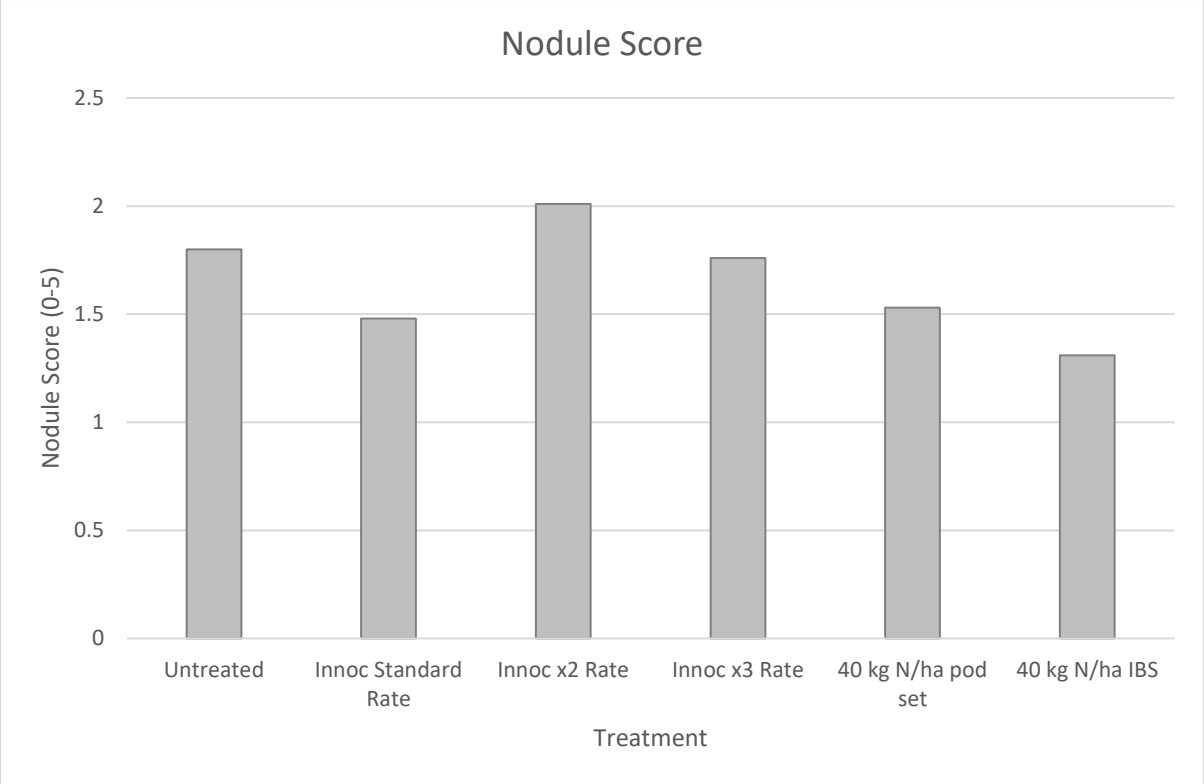


**Figure 1.** Influence of treatments tested on root nodule scores (0-5 scale) Assessed at 9 node 17-Jul – cv PBA Bendoc.

6 plants were randomly dug out from each plot, roots were gently washed to remove soil. The nodules were counted as effective (pink outside and healthy pink inside) and non-effective (black, white and green). A score based on the number and distribution of effective nodules was calculated from the table below.

**Table 3.** Nodule scoring system.

| Nodule Score | Distribution and Number of Effective Nodules | |
|---|---|---|
| | Crown (Top 5cm) | Elsewhere |
| **0** | 0 | 0 |
| **0.5** | 0 | 1 to 4 |
| **1.0** | 0 | 5 to 9 |
| **1.5** | 0 | >10 |
| **2.0** | <10 | 0 |
| **2.5** | <10 | <10 |
| **2.75** | <10 | >10 |
| **3.0** | >10 | 0 |
| **4.0** | >10 | <10 |
| **5.0** | >10 | >10 |



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## Trial 4 Disease Management Strategies for Faba Beans Grown Under Irrigation

**Location:** Finley IRC
**FAR Code:** FAR F20-07-1
**Sown:** 28 April 2020
**Cultivar:** PBA Amberley and Fiesta VF
**Harvested:** 30th November 2020
**Rotation position:** Wheat (2019), Faba beans (2018), Fallow after Rice (2017)
**Soil Management:** Cultivation with speed disc to incorporate stubble in Autumn
**Irrigation:** Overhead lateral irrigation 6 x 25mm in spring. Total applied 150mm (1.5 ML/ha)
**GSR:** April-October 244mm. Total water available (GSR + Irr) 394mm

**Key Messages:**

- *Neither PBA Amberley or Fiesta VF gave a significant yield response to either three spray foliar fungicide programme.*
- *PBA Amberley had lower disease incidence than Fiesta VF but levels of disease were very low.*
- *Both fungicide strategies had good control of low disease levels compared to the untreated plots.*
- *An accidental overspray by a farm contractor applied tebuconazole 145ml/ha for cercospora at the vegetative stage to the whole trial on 1st August. This may have reduced the response to fungicide over the untreated.*
- *Based on a trial mean of 6.4t/ha the WUE was 22.5kg/mm.*

**Table 1.** Fungicide strategies applied to the trial.

| | | Treatment mL/ha | | |
|---|---|---|---|---|
| | **Strategy** | **6 Node** | **Early-Flower** | **Mid-Flower** |
| | | (7 July) | (4 Sep) | (2 Oct) |
| **1.** | **Untreated** | - | - | - |
| **2.** | **Expensive** | Veritas @ 1 L/ha | Aviator Xpro @ 600mL/ha | Veritas @ 1 L/ha |
| **3.** | **Cheap** | Tebuconazole 430 @ 145 mL/ha | Chlorothalonil 720 @ 1.4 L/ha | Chlorothalonil 720 @ 1.4 L/ha |

*Please note a contractor overspray of fungicide (tebuconazole 145ml/ha) was made on 1st August for cercospora which may have reduced disease in all treatments*

**Table 2.** Influence of fungicide strategy on grain yield under different fungicide strategies.

| | | Grain Yield | | |
|---|---|---|---|---|
| | | **PBA Amberley** | **Fiesta VF** | **Mean** |
| | **Treatment** | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** |
| **1.** | **Untreated** | 6.15 - | 6.31 - | **6.23 -** |
| **2.** | **Expensive** | 6.36 - | 6.66 - | **6.51 -** |
| **3.** | **Cheap** | 6.53 - | 6.40 - | **6.46 -** |
| | **Mean** | **6.34 -** | **6.46 -** | |

| | | | |
|---|---|---|---|
| **LSD Fungicide p = 0.05** | ns | **P val** | 0.104 |
| **LSD Cultivar p=0.05** | ns | **P val** | 0.733 |
| **LSD Fungicide x Cultivar P=0.05** | ns | **P val** | 0.286 |



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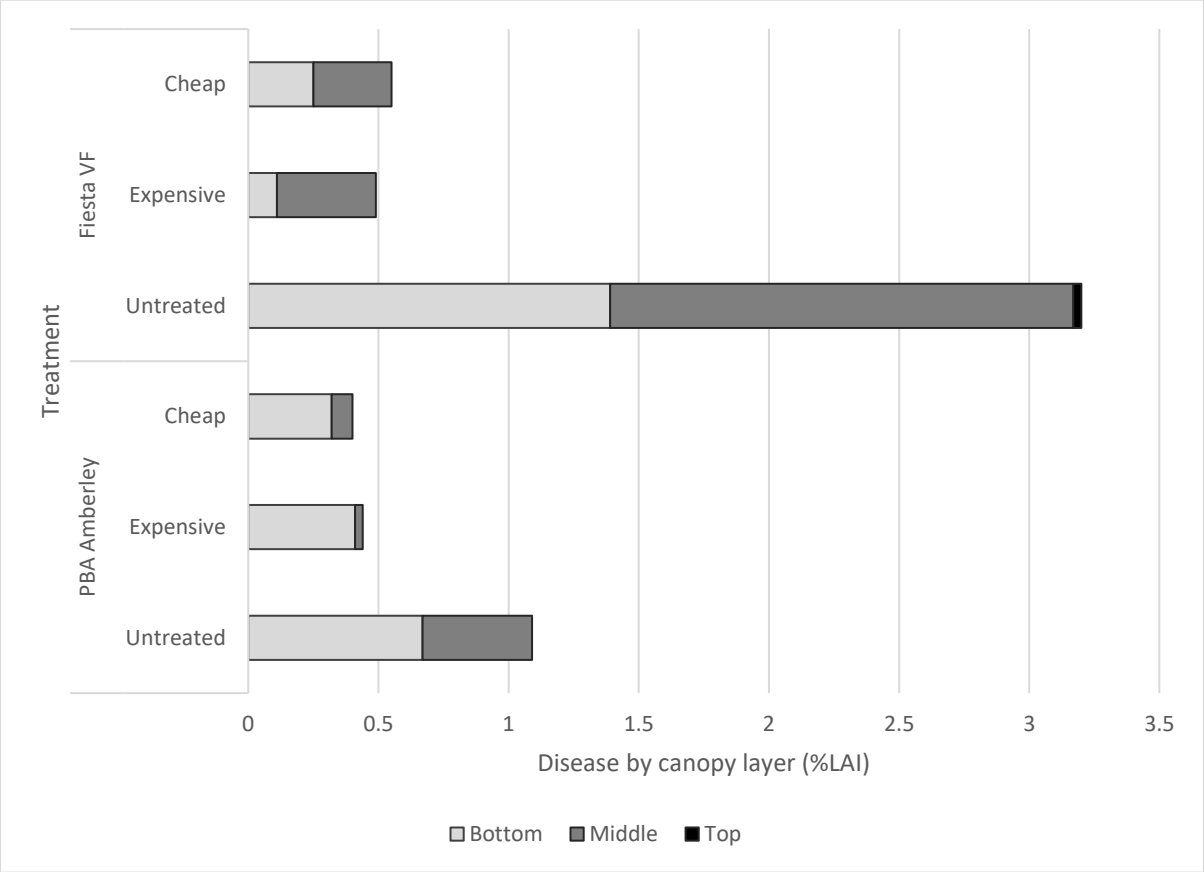


**Figure 1.** Cercospora leaf spot infection 28 days after fungicide application at mid-flower – Assessed 28-Oct at GS83.

*Please note a contractor overspray of fungicide (tebuconazole 145ml/ha) was made on 1st August for cercospora which may have reduced disease in all treatments.*



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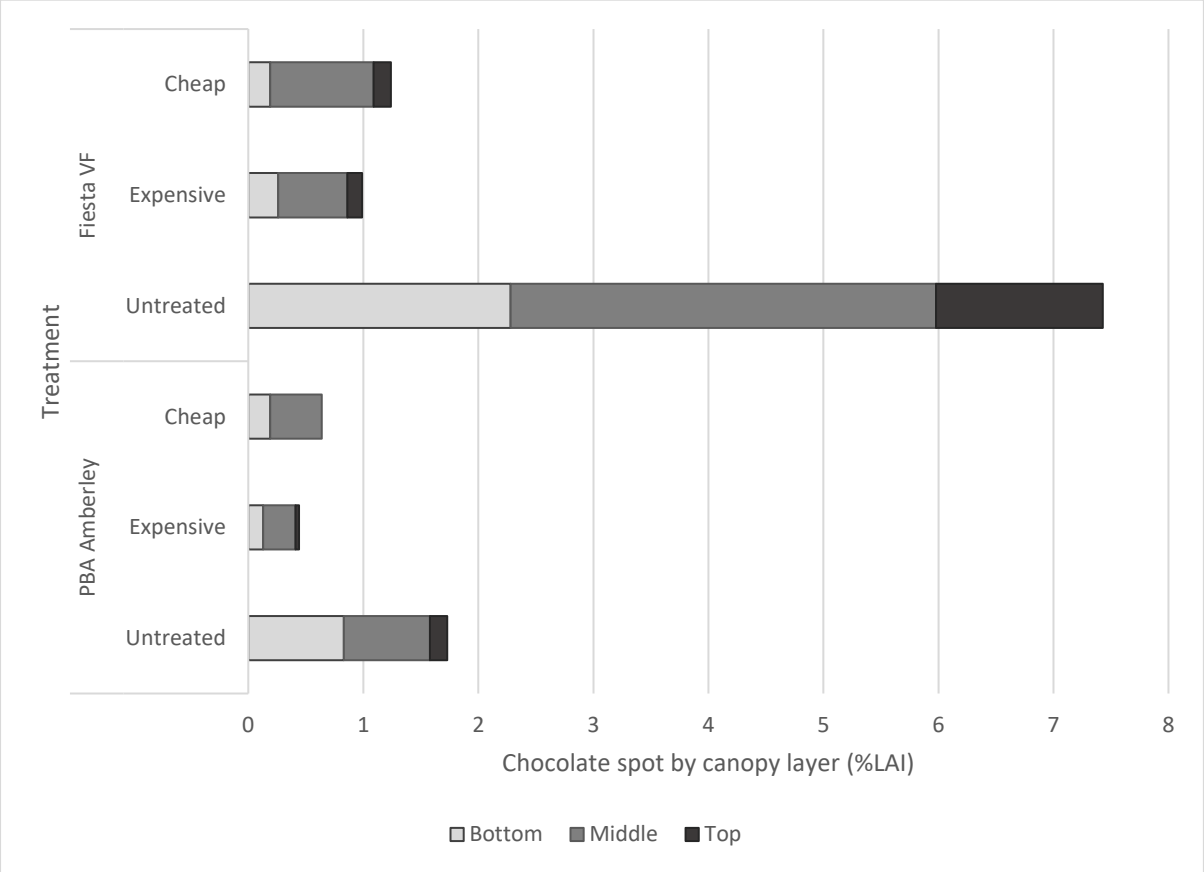


**Figure 2.** Influence of fungicide strategy on Chocolate spot infection 28 days after fungicide application at mid-flower – Assessed 28-Oct at GS83.

*Please note a contractor overspray of fungicide (tebuconazole 145ml/ha) was made on 1st August for cercospora which may have reduced disease in all treatments.*



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## Trial 5 Influence of Plant Growth Regulation on Faba Bean Yield and Profitability Under Irrigation

**Location:** Finley IRC
**FAR Code:** FAR F20-09-1
**Sown:** 28 April 2020
**Cultivar:** PBA Bendoc
**Harvested:** 30th November 2020
**Rotation position:** Wheat (2019), Faba beans (2018), Fallow after Rice (2017)
**Soil Management:** Cultivation with speed disc to incorporate stubble in Autumn
**Irrigation:** Overhead lateral irrigation 6 x 25mm in spring. Total applied 150mm (1.5 ML/ha)
**GSR:** April-October 244mm. Total water available (GSR + Irr) 394mm

**Key Messages:**

- *Experimental PGR application in irrigated faba beans gave no significant yield effects although application influenced crop height at early pod set and harvest in this irrigated trial.*
- *Applying a single experimental PGR (FAR PGR 1) applications at the start of flowering had a significant effect on plant height at pod set and harvest*
- *Sequencing this earlier treatment with FAR PGR 2 at the end of flowering had no further effect on crop height.*
- *Reducing plant population to 12 plants/m$^2$ reduced yield significantly compared to 19 and 29 plants/m2, with 29 plants/m2 associated with the highest yields in the trial.*
- *Reducing plant population reduced crop height at pod set (a reduction in height of 6cm for every 7-10 plants/m$^2$ reduction in plant population), but had no significant effect on final crop height at harvest*
- *There was no lodging recorded in this trial*
- *Based on 5.03 t/ha the Water Use Efficiency was 17.7 kg/mm (total water available – 110mm soil evaporation).*

**Table 1.** Influence of seed rate (plant population) and PGR application on grain yield (t/ha).

| | Seed Rate (Plants/m$^2$) | | | |
|---|---|---|---|---|
| | **12 seeds/m$^2$ (12 plants/m$^2$)** | **24 seeds/m$^2$ (19 plants/m$^2$)** | **36 seeds/m$^2$ (29 plants/m$^2$)** | **Mean** |
| | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** |
| **Untreated** | 3.94 - | 4.91 - | 5.18 - | **4.68 -** |
| **FAR PGR 1 GS61** | 3.91 - | 4.79 - | 5.09 - | **4.60 -** |
| **FAR PGR 1 GS61, PGR 2 GS 69** | 3.90 - | 4.65 - | 4.82 - | **4.45 -** |
| **Mean** | **3.92 b** | **4.78 a** | **5.03 a** | |
| | | | | |
| **LSD Seed Rate p = 0.05** | 0.38 | | **P val** | <0.001 |
| **LSD PGR Strategy p=0.05** | ns | | **P val** | 0.404 |
| **LSD Seed Rate x PGR P=0.05** | ns | | **P val** | 0.942 |

*Yield figures followed by different letters are considered to be statistically different (p=0.05)*



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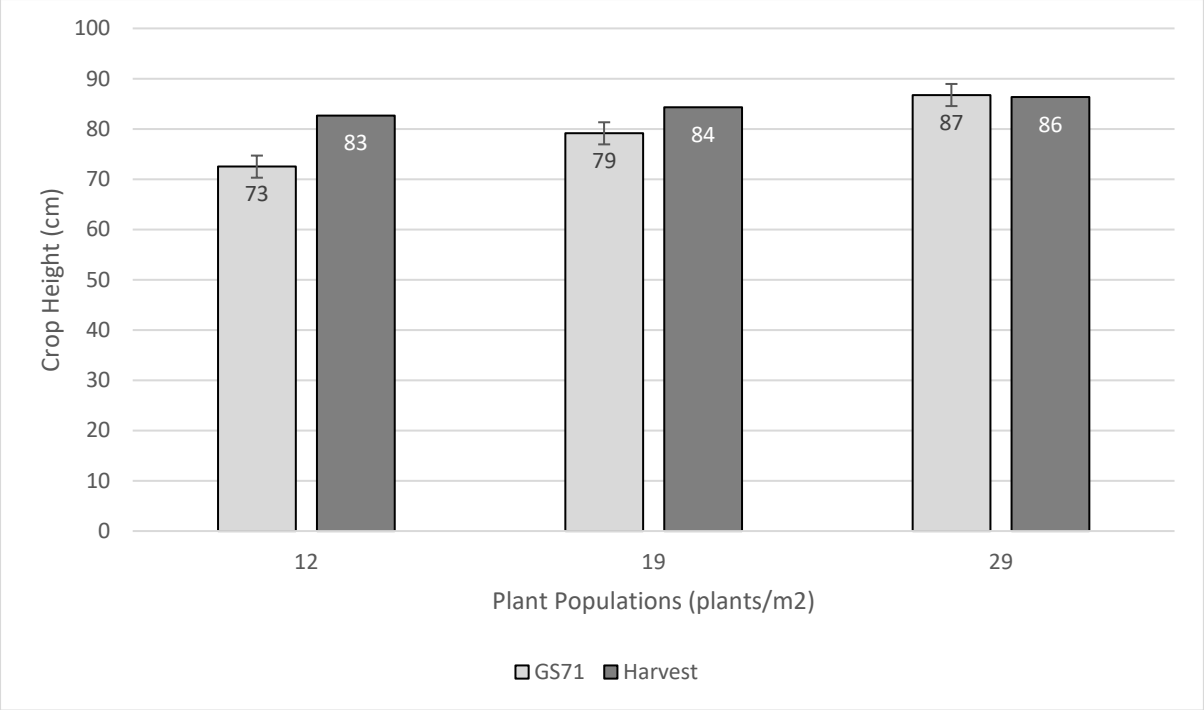


**Figure 1.** Plant population effect on crop height at GS71 (24-Sep) and pre-harvest (26-Nov). GS71 – P value 0.002, LSD 4.4cm. Harvest - P value 0.495, LSD ns.

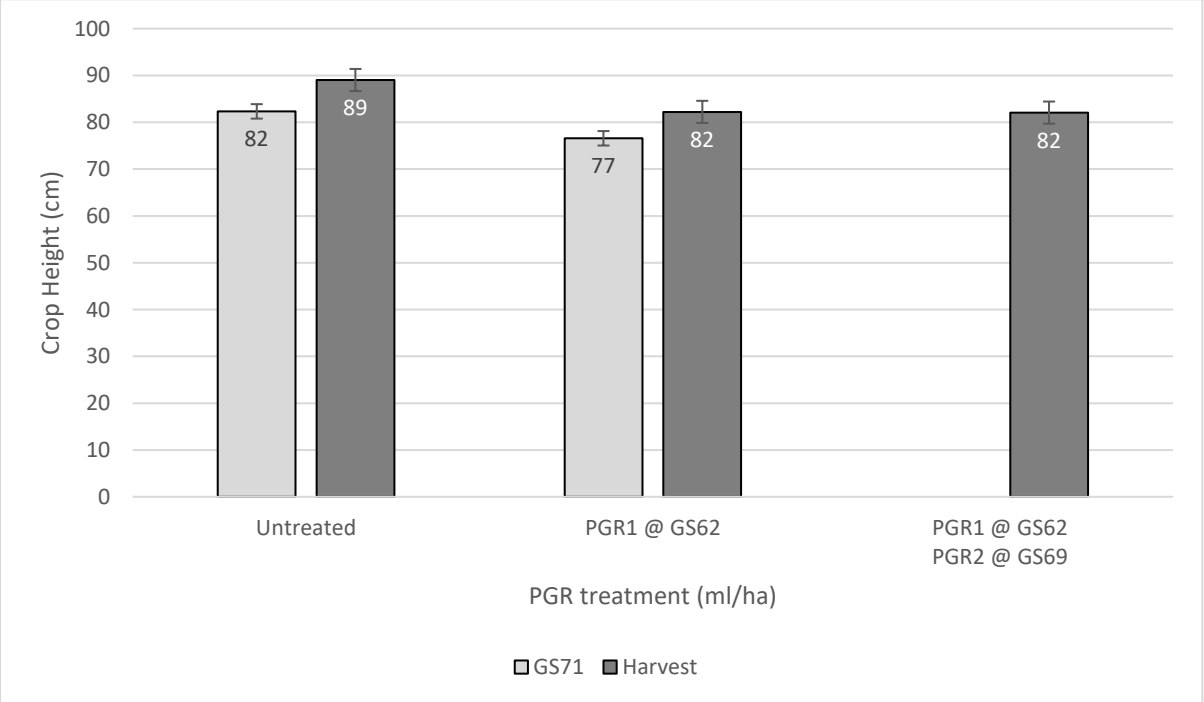


**Figure 2.** PGR effect on crop height at GS71 (24-Sep) and pre harvest (26-Nov). GS71 – P value=0.002, LSD 3.1. Harvest – P value=0.009, LSD 4.7cm.

Released:24 February 2021

The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

# Kerang VIC

*Irrigated trials conducted at the Kerang irrigated research centre 2020 were managed by the Irrigated Cropping Council.*

## Trial 1 Optimum Plant Population Under Sprinkler Irrigation

**Location:** Kerang, Victoria
**FAR Code:** ICC F20-01-3
**Sown:** 8 May 2020
**Cultivar:** PBA Amberley and Farah
**Harvested:** 16 December 2020
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Overhead sprinkler irrigation 5 timings, totalling 129mm (1.29 ML/ha)
**GSR:** April-October 250mm. Total water available 379mm

***Key Messages:***

- *Establishment rate for the trial averaged 90%.*
- *There were small differences in early canopy development in early August that became significant at the beginning of flowering. Farah tended to have similar biomass to PBA Amberley.*
- *At harvest, only PBA Amberley was assessed for biomass, and there was no significant difference between the sowing rates.*
- *At harvest, PBA Amberley and Farah had similar yields with the 18, 24 and 36 seeds/m$^2$ seeding rate.*
- *An 18 seeds/m$^2$ equated to 16 plants /m$^2$ plant establishment.*
- *Harvest Index ranged from 0.43 to 0.72 but was influenced by the variable biomass data.*
- *Water use efficiency was 10.8 kg/mm*

**Table 1.** Establishment - Plant population (plants/m$^2$) established from four seed rates with two different cultivars grown under sprinkler irrigation.

| | Established Population | | |
|---|---|---|---|
| **Seed Rate** | **PBA Amberley** | **Farah** | **Mean** |
| | **Plants/m$^2$** | **Plants/m$^2$** | **Plants/m$^2$** |
| **10 seeds/m$^2$** | 8.5 e | 8.8 e | **8.6 c** |
| **18 seeds/m$^2$** | 13.8 de | 19.7 cd | **16.7 b** |
| **24 seeds/m$^2$** | 21.8 bcd | 22.9 bc | **22.4 b** |
| **36 seeds/m$^2$** | 29.2 ab | 34.5 a | **31.9 a** |
| **Mean** | **18.3** | **21.5** | |

| | | | |
|---|---|---|---|
| **LSD Seed Rate p = 0.05** | 5.98 | **P val** | <0.001 |
| **LSD Cultivar p=0.05** | NS | **P val** | 0.134 |
| **LSD Seed Rate x Cultivar.** | 8.46 | **P val** | 0.689 |



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**Table 2.** Canopy measurements – dry matter (DM t/ha).

| Dry matter (t/ha) | | | | |
|---|---|---|---|---|
| **Sowing Rate (seeds/m²)** | 10 | 18 | 24 | 36 |
| **Plant Pop** | | | | |
| **PBA Amberley** | 9 | 14 | 22 | 29 |
| **Farah** | 9 | 20 | 23 | 35 |
| **Vegetative 6 August** | | | | |
| **PBA Amberley** | 0.58 b | 0.50 b | 0.79 b | 0.72 b |
| **Farah** | 0.80 b | 0.76 b | 1.25 a | 1.31 a |
| | $p_{var}$ = <0.001, $p_{rate}$ = 0.012, $p_{vxr}$ = 0.514, lsd $_{vxr}$ = 0.405, cv% = 32.9 | | | |
| **Early Flowering** | | | | |
| **PBA Amberley** | 1.55 b | 2.06 b | 2.84 ab | 2.79 ab |
| **Farah** | 1.73 b | 2.53 ab | 3.75 a | 3.37 a |
| | $p_{var}$ = 0.119, $p_{rate}$ = 0.010, $p_{vxr}$ = 0.902, lsd $_{vxr}$ = 1.421, cv% = 37.4 | | | |
| **Harvest** | | | | |
| **PBA Amberley** | 7.32 | 6.57 | 6.42 | 5.31 |
| **Farah** | | | 8.36 | |
| | p = 0.321, lsd = NS, cv% = 18.6 | | | |

All biomass analysis should be treated with caution due to the high cv%.

Farah demonstrated higher biomass when compared to PBA Amberley at the higher seeding rates at early August. By early flowering, there was no difference between the varieties at the higher rates, but looking at Amberley alone, sowing rate made no difference to biomass.
At harvest this trend continued with all sowing rates in Amberley having similar biomass. Maximum biomass achieved at harvest by PBA Amberley was 7.32t DM/ha at the lowest seeding rate.

**Table 3**. Yield (t/ha), grain quality (g/100seeds/m2) and harvest index.

| **Grain Yield (t/ha)** | | | | |
|---|---|---|---|---|
| **Sowing Rate (seeds/m²)** | 10 | 18 | 24 | 36 |
| **PBA Amberley** | 3.29 c | 4.31 a | 4.59 a | 4.38 a |
| **Farah** | 3.59 bc | 3.96 ab | 4.35 a | 4.37 a |
| | $p_{var}$ = 0.754, $p_{pop}$ = 0.001, $p_{vxp}$ = 0.445, lsd $_{vxp}$ = .660, cv% = 9.2 | | | |
| **Seed Size (g/100 seeds)** | | | | |
| **PBA Amberley** | 82.1 a | 81.3 ab | 80.6 ab | 81.8 a |
| **Farah** | 78.7 ab | 76.1 bc | 71.2 c | 73.2 c |
| | $p_{var}$ = <0.001, $p_{rate}$ = 0.176, $p_{vxr}$ = 0.396, lsd $_{vxr}$ = 5.41, cv% = 4.0 | | | |
| **Harvest Index** | | | | |
| **PBA Amberley** | 0.43 | 0.59 | 0.62 | 0.72 |
| **Farah** | | | 0.44 | |
| | p = 0.136, lsd = NS, cv% = 22.1 | | | |



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Highest yield grain was from the 24 seeds/$m^2$ rate in Amberley, but not significantly different to the 18 and 36 seeds/m2 in both varieties. 18 seeds/$m^2$ equates to a plant population of approximately 16 plants/$m^2$.

Seed size in Amberley was not affected by sowing rate, although seeding rate did influence seed size in Farah.

Harvest Index was not influenced by seeding rate, however the data should be viewed with caution due to the high variability of the data.

The average yield for the trial was 4.1 t/ha. This represents a WUE of 15.2 kg/mm.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Trial 2 Optimum Plant Population Under Flood Irrigation

**Location:** Kerang, Victoria
**FAR Code:** ICC F20-01-4
**Sown:** 8 May 2020
**Cultivar:** PBA Amberley and Farah
**Harvested:** 15 December 2020
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Flood irrigation 3 applications totalling 330mm (3.3 ML/ha)
**GSR:** April-October 250mm. Total water available 580mm

***Key Messages:***

- *Establishment rate for the trial averaged 99%.*
- *There were small differences in early canopy development in early August that became significant at the beginning of flowering. Farah tended to have greater biomass than PBA Amberley.*
- *At harvest, only PBA Amberley was assessed for biomass, and there was no significant difference between the sowing rates.*
- *At harvest, PBA Amberley had similar yields with the 18, 24 and 36 seeds/m$^2$ sowing rate.*
- *Farah had similar yields across all sowing rates.*
- *An 18 seeds/m$^2$ equated to 18 plants /m$^2$ establishment.*
- *Harvest Index ranged from 0.37 to 0.73 but was influenced by the variable biomass data.*
- *Water use efficiency was 15.4 kg/mm*

**Table 1.** Establishment - Plant population (plants/m$^2$) established from four seed rates with two different cultivars grown under flood irrigation.

| | Established Population | | |
|---|---|---|---|
| **Seed Rate** | **PBA Amberley** | **Farah** | **Mean** |
| | **Plants/m$^2$** | **Plants/m$^2$** | **Plants/m$^2$** |
| **10 seeds/m$^2$** | 13.4 d | 14.1 d | **13.7 d** |
| **18 seeds/m$^2$** | 16.2 cd | 20.1 bc | **18.1 c** |
| **24 seeds/m$^2$** | 23.9 b | 24.7 b | **24.3 b** |
| **36 seeds/m$^2$** | 32.0 a | 35.6 a | **33.8 a** |
| **Mean** | **21.4** | **23.6** | |

| | | | |
|---|---|---|---|
| **LSD Seed Rate p = 0.05** | 2.85 | **P val** | <0.001 |
| **LSD Cultivar p=0.05** | NS | **P val** | 0.287 |
| **LSD Seed Rate x Cultivar.** | 4.03 | **P val** | 0.905 |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 2.** Canopy measurements – dry matter (DM t/ha).

| Dry matter (t/ha) | | | | |
|---|---|---|---|---|
| **Sowing Rate (seeds/m²)** | 10 | 18 | 24 | 36 |
| **Vegetative 6 August** | | | | |
| **PBA Amberley** | 1.00 b | 1.55 ab | 1.42 ab | 1.53 ab |
| **Farah** | 1.07 b | 1.28 b | 1.58 ab | 1.92 a |
| | $p_{var}$ = 0.553, $p_{rate}$ = 0.023, $p_{vxr}$ = 0.473, lsd $_{vxr}$ = 0.608, cv% = 29.1 | | | |
| **Early Flowering** | | | | |
| **PBA Amberley** | 3.53 cd | 4.79 bcd | 4.29 cd | 5.04 bcd |
| **Farah** | 3.38 d | 5.17 bc | 6.10 ab | 6.90 a |
| | $p_{var}$ = 0.026, $p_{rate}$ = 0.002, $p_{vxr}$ = 0.229, lsd $_{vxr}$ = 1.696, cv% = 23.5 | | | |
| **Harvest** | | | | |
| **PBA Amberley** | 11.12 | 9.69 | 11.06 | 11.40 |
| **Farah** | | | 16.7 | |
| | p = 0.770, lsd = NS, cv% = 22.9 | | | |

*All biomass analysis should be treated with caution due to the high cv%.*

Farah demonstrated higher biomass when compared to PBA Amberley at the higher seeding rates at early flowering. This trend continued at harvest (24 seeds/m$^2$ rate only) but was not statistically different due to the large variation in the data.

Maximum biomass achieved at harvest by PBA Amberley was 11.4 t DM/ha at the highest seeding rate, but was not statistically different to all other seeding rates.

**Table 3**. Yield and grain quality.

| **Grain Yield (t/ha)** | | | | |
|---|---|---|---|---|
| **Sowing Rate (seeds/m²)** | 10 | 18 | 24 | 36 |
| **PBA Amberley** | 6.78 c | 7.65 ab | 7.88 a | 7.83 a |
| **Farah** | 6.62 c | 6.77 c | 7.03 bc | 6.97 c |
| | $p_{var}$ = <0.001, $p_{pop}$ = 0.009, $p_{vxp}$ = 0.302, lsd $_{vxp}$ = 0.642, cv% = 6.1 | | | |
| Seed Size (g/100 seeds) | | | | |
| **PBA Amberley** | 73.8 | 72.8 | 75.3 | 74.0 |
| **Farah** | 72.0 | 73.2 | 73.5 | 73.8 |
| | $p_{var}$ = 0.162, $p_{rate}$ = 0.248, $p_{vxr}$ = 0.487, lsd $_{vxr}$ = NS, cv% = 2.4 | | | |
| Harvest Index | | | | |
| **PBA Amberley** | 0.55 | 0.73 | 0.65 | 0.61 |
| **Farah** | | | 0.37 | |
| | p = 0.329, lsd = NS, cv% = 21.3 | | | |

Highest yield grain was from the highest rate (36 seeds/m$^2$) of PBA Amberley. However the yields of the 18, 24 and 36 seeds/m2 was statistically similar.



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All seeding rates of Farah had similar yields.

PBA Amberley was the higher yielding variety.

Seed size was not influenced by variety or seeding rate.

Harvest Index was highly variable, due to the variation in the biomass data obtained via quadrat cuts and should be viewed with caution.

The average yield for the trial was 7.2 t/ha. This represents a WUE of 15.0 kg/mm.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Trial 3 Disease Management Strategies for Faba Beans Grown Under Irrigation

**Location:** Kerang, Victoria
**FAR Plot:** ICC F20-07-2
**Sown:** 18 May 2020
**Cultivar:** PBA Samira and Farah
**Harvested:** 16 December 2020
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Flood irrigation 3 applications totalling 320mm (3.2 ML/ha)
**GSR:** April-October 250mm. Total water available 570mm

***Key Messages:***

- *Disease pressure was low for the season and very little disease was observed in the trial.*
- *Analysis of the yield data indicates that the 'expensive' fungicide strategy did improve grain yield.*

**Table 1.** Fungicide strategies tested.

| **Strategy** | **Crop Growth Stage** | | |
|---|---|---|---|
| | Vegetative | Early Flowering | Early Podding |
| **Untreated (control)** | No Fungicide | No Fungicide | No Fungicide |
| **'Cheap'** | 145 ml/ha tebuconazole | 1.0 l/ha chlorothalonil | 1.0 l/ha chlorothalonil |
| **'Expensive'** | 1.0 l/ha Veritas | 0.6 l/ha Aviator | 1.0 l/ha Veritas |

**Table 2**a. Fungicide strategy and yield (t/ha).

| **Strategy** | **Yield (t/ha)** |
|---|---|
| **Untreated (Control)** | 6.58 b |
| **'Cheap'** | 6.48 b |
| **'Expensive'** | 6.99 a |
| **P val** | 0.006 |
| **LSD** | 0.298 |
| **cv%** | 4.2 |

**Table 2b.** 2 Way ANOVA: Yield (t/ha).

| **Strategy** | **Farah** | **PBA Samira** |
|---|---|---|
| **Untreated (Control)** | 6.32 ab | 6.84 c |
| **'Cheap'** | 6.22 a | 6.74 c |
| **'Expensive'** | 6.69 bc | 7.29 d |
| | $p_{var}$ = <0.001, $p_{fun}$ = 0.006, $p_{vxf}$ = 0.952, $lsd_{vxf}$ = 0.42, cv% = 4.2 | |

Analysis of the yield data indicated that there was no interaction between variety and fungicide strategy (p = 0.952).



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PBA Samira was a higher yielding cultivar than Farah (6.96 t/ha vs 6.41 t/ha, p = <0.001, lsd = 0.243) and the 'expensive' strategy was higher yielding than the 'cheap' and untreated strategies.

Disease assessments through the later part of the season only found low levels of disease in the lower canopy. Foliar lesions were identified as cercospera, and mainly on the leaves that were beginning to senesce deep in the canopy.



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## Trial 4 Influence of Plant Growth Regulation on Faba Bean Yield and Profitability Under Irrigation

**Location:** Kerang, Victoria
**FAR Code:** ICC F20-09-2
**Sown:** 18 May 2020
**Cultivar:** PBA Bendoc
**Harvested:** 16 December 2020
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Flood irrigation 3 applications totalling 320mm (3.2 ML/ha)
**GSR:** April-October 250mm. Total water available 570mm

***Key Messages:***

- *Yield was reduced by the late application of 'PGR2', which could be partially explained by the smaller bean size of the plots treated with 'PGR2'*
- *Some height reduction was measured by the 1 application of 'PGR1' at early flowering. A further application of 'PGR2' at late flowering did not affect final plant height.*
- *Lodging was influenced more by population than PGR application, with the low population of 12 seeds/m2 having the least lodging and yielding similar to the higher population treatments.*

**Table 1.**Faba Bean treatments to reduce lodging and brackling.

| **Treatments** | |
|---|---|
| | Vegetative |
| **Population** | 12, 24 and 36 seeds/m2 |
| **Single PGR** | 'PGR1' at early flowering |
| **Dual PGR** | 'PGR1' at early flowering + 'PGR2' at end of flowering |

**Table 2.** Establishment - Plant population (plants/$m^2$) established from three seed rates grown under flood irrigation.

| **Seed Rate** | **PBA Bendoc** |
|---|---|
| | **Plants/$m^2$** |
| **12 seeds/$m^2$** | 13.4 c |
| **24 seeds/$m^2$** | 23.7 b |
| **36 seeds/$m^2$** | 32.8 a |
| **Mean** | **23.9** |
| | |
| **P Seed Rate p = 0.05** | <0.001 |
| **LSD Seed Rate p=0.05** | 3.20 |
| **cv%** | 16.5 |

Analysis of the yield, seed size, plant height or lodging score at harvest data indicated that there was no interaction between population and PGR strategy for any of these parameters measured.

As presented in Table 3a, population had no effect on yield, seed size or plant height. It did, however influence lodging score. The result should be viewed with caution due to the large variability in the data.



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Table 3b illustrates the effect of the PGR applications. Yield was reduced with the use of 'PGR2' in the dual PGR treatment, as was seed size. Seed size was 93.5% of the untreated control, which is close to the reduced yield of 92.2%.

Lodging score for the single PGR was lower than that of the control and the dual application, but as there was considerable variability in the data, this result should be viewed with caution.

**Table 3a**. Effect of population on yield, bean size, plant height and lodging score.

| Strategy | Yield (t/ha) | Seed Size (g/100s) | Plant Height (cm) | Lodging Score |
|---|---|---|---|---|
| **12 seeds/m$^2$** | 7.42 | 67.3 | 101.2 | 1.6 a |
| **24 seeds/m$^2$** | 7.40 | 67.9 | 107.1 | 3.3 b |
| **36 seeds/m$^2$** | 6.74 | 67.8 | 102.5 | 3.4 b |
| **p** | 0.631 | 0.688 | 0.126 | <0.001 |
| **lsd** | NS | NS | NS | 0.866 |
| **cv%** | 6.3 | 2.9 | 6.8 | 30.6 |

**Table 3b**. Effect of PGR on yield, bean size, plant height and lodging score.

| Strategy | Yield (t/ha) | Seed Size (g/100s) | Plant Height (cm) | Lodging Score |
|---|---|---|---|---|
| **Untreated (control)** | 7.31 a | 69.4 a | 109.6 a | 3.0 a |
| **Single PGR** | 7.30 a | 68.7 a | 100.4 b | 4.0 b |
| **Dual PGR** | 6.74 b | 64.9 b | 100.8 b | 3.1 a |
| **p** | 0.006 | <0.001 | 0.006 | 0.046 |
| **lsd** | 0.3798 | 1.665 | 5.96 | 0.866 |
| **cv%** | 6.3 | 2.9 | 6.8 | 30.6 |



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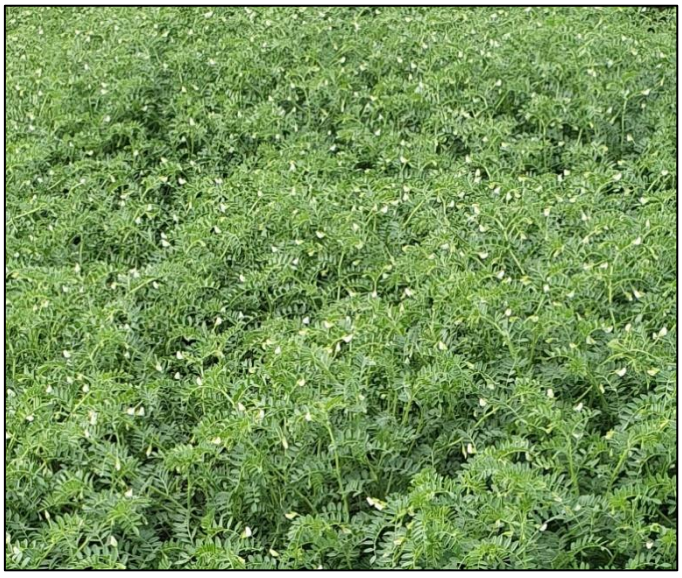
Optimising Irrigated Grains

# Optimising Irrigated Grains (FAR1906-003RTX)

**A Grains Research & Development Corporation (GRDC) investment**

## PROVISIONAL HARVEST RESULTS:

# Irrigated Chickpea Trials



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# Finley Irrigated Research Centre NSW

*Irrigated trials conducted at the Finley irrigated research centre 2020 were managed by FAR Australia, hosted by Southern Growers.*

## Trial 1 April Sown Chickpeas Under Overhead Irrigation

**Protocol objective:** Assess the performance of chickpeas sown in late April at different plant populations. *(note the intention had been to irrigate for emergence compared to Trial 2 where chickpeas under flood would be evaluated. Instead chickpeas were sown under overhead irrigation on 27 April (Trial 1) and the identical trial sown on 19 May)*

**Location:** Finley IRC
**FAR Code:** CP20-01-1
**Sown:** 27 April 2020
**Cultivar:** Genesis 090 and PBA Royal
**Harvested:** 11th December 2020
**Rotation position:** Wheat (2019), Faba beans (2018), Fallow after Rice (2017)
**Soil Management:** Cultivation with speed disc to incorporate stubble in Autumn
**Irrigation:** Overhead lateral Irrigation 6 x 25mm in spring. Total applied 150mm (1.5 Ml/ha)
**GSR:** April-October 244mm**.** Total water available (GSR+Irr) 394mm

**Key Messages:**

- *Chickpeas sown 27 April under overhead irrigation gave yields of between 3.1 – 3.58t/ha (cv Genesis 090) and 3.0 – 3.35t/ha (cv PBA Royal).*
- *Neither plant populations (11- 38 plants/$m^2$) or cultivar had a significant impact on chickpea grain yield at this early sowing date, although with both cultivars the lowest yields were recorded at the lowest plant populations (11 – 13 plants/m2).*
- *There were no significant differences in pod number due to cultivar or plant population and in the height of the first pods due to plant population, although a trend suggested lower height to first pod at lower plant populations.*
- *Significant interactions were observed between plant population and cultivar on dry matter (DM) production at early flowering; Genesis 090 maximised DM production at 38 plants/$m^2$ whilst PBA Royal maximised DM production at a lower plant population (28 plants/$m^2$).*
- *There were no significant differences in DM at harvest (PBA Royal) with an average of 8.22t/ha and a harvest index of 38.8% (data not shown).*
- *The WUE for Genesis 090 based on average yield of 3.45t/ha was 12.1kg/mm.*



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 1.** Influence of seed rates (plant populations) on grain yield (t/ha) with two different varieties grown under overhead irrigation.

| | | Grain Yield | | |
|---|---|---|---|---|
| **Plants/m² (actual)** | | **Genesis 090** | **PBA Royal** | **Mean** |
| **Genesis 090** | **PBA Royal** | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** |
| 11 | 13 | 3.10 - | 3.00 - | **3.05 -** |
| 22 | 19 | 3.53 - | 3.24 - | **3.39 -** |
| 25 | 28 | 3.57 - | 3.35 - | **3.46 -** |
| 38 | 34 | 3.58 - | 3.18 - | **3.38 -** |
| **Mean** | | **3.45 -** | **3.19 -** | |

| | | | |
|---|---|---|---|
| **LSD Cultivar p=0.05** | ns | **P val** | 0.211 |
| **LSD Seed Rate p = 0.05** | ns | **P val** | 0.197 |
| **LSD Seed Rate x Cultivar.** | ns | **P val** | 0.901 |

**Table 2.** Influence of seed rate and cultivar on plant population – assessed V6, 12-June.

| **Treatment** | | | |
|---|---|---|---|
| | **Genesis 090** | **PBA Royal** | **Mean** |
| **Seed Rate** | **Plants/m²** | **Plants/m²** | **Plants/m²** |
| 15seeds/m² | 11 - | 13 - | **12 d** |
| 25 seeds/m² | 22 - | 19 - | **20 c** |
| 35 seeds/m² | 25 - | 28 - | **27 b** |
| 45 seeds/m² | 38 - | 34 - | **36 a** |
| **Mean** | **24 -** | **23 -** | |

| | | | |
|---|---|---|---|
| **Cultivar LSD** | ns | **P val** | 0.652 |
| **Seed Rate LSD** | 4.6 | **P val** | <0.001 |
| **Cultivar x seed rate LSD** | ns | **P val** | 0.371 |

**Table 3.** Influence of plant population and cultivar on canopy composition, pods/m², height to first pod (cm), and harvest dry matter (t/ha) – assessed at harvest, 2-December.

| **Treatment** | **Canopy composition** | | **Harvest Dry Matter** |
|---|---|---|---|
| | **Pods/m²** | **1st Pod Height (cm)** | **t/ha** |
| **Genesis 090** | | | |
| 25 plants/m² | 1209 - | 40 a | 7.80 - |
| **PBA Royal** | | | |
| 13 plants /m² | 1115 - | 34 b | 8.41 - |
| 19 plants /m² | 1169 - | 37 ab | 8.62 - |
| 28 plants /m² | 1073 - | 39 a | 8.10 - |
| 34 plants /m² | 1111 - | 39 a | 7.74 - |
| **Mean** | **1135** | **38** | **8.13** |
| **LSD Seed rate x cultivar** | ns | 3.5 | ns |
| **P val** | 0.927 | 0.036 | 0.755 |

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**Table 4.** Influence of plant population and cultivar on dry matter production at early flowering (R2) – assessed 28 September.

| | | Dry Matter Production Early Flowering (GS62) | | |
|---|---|---|---|---|
| **Plants/m² (actual)** | | Plants/m² (actual) | **PBA Royal** | **Mean** |
| **Genesis 090** | **PBA Royal** | **t/ha** | **t/ha** | **t/ha** |
| 11 | 13 | 3.04 cd | 2.38 d | **2.71 b** |
| 22 | 19 | 3.24 cd | 2.68 d | **2.96 b** |
| 25 | 28 | 3.74 bc | 5.08 a | **4.41 a** |
| 38 | 34 | 4.47 ab | 4.82 a | **4.64 a** |
| **Mean** | | **3.62 b** | **3.74 a** | |

| | | | |
|---|---|---|---|
| **LSD Cultivar p=0.05** | 0.11 | **P val** | 0.039 |
| **LSD Seed Rate p = 0.05** | 0.64 | **P val** | <0.001 |
| **LSD Seed Rate x Cultivar.** | 0.90 | **P val** | 0.015 |



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## Trial 2 May Sown Chickpeas Under Overhead Irrigation

**Protocol objective:** Assess the performance of later sown chickpeas grown at different plant populations *(note this was set up to assess the performance of chickpeas that it was thought that would been established on natural rainfall, however in 2020 both April and May sowings were established with natural rainfall).*

**Location:** Finley IRC
**FAR Code:** FAR CP20-01-2
**Sown:** 19 May
**Cultivar:** Genesis 090 and PBA Royal
**Harvested:** 11th December 2020
**Rotation position:** Wheat (2019), Faba beans (2018), Fallow after Rice (2017)
**Soil Management:** Cultivation with speed disc to incorporate stubble in Autumn
**Irrigation:** Overhead lateral irrigation 6 x 25mm in spring Total applied 150mm (1.5 ML/ha)
**GSR:** April-October 244mm. Total water available (GSR + Irr) 394mm

**Key Messages:**

- *Though not statistically comparable the later sown identical trial gave lower yields than the earlier sowing (27 April – Trial 1), 2.39 – 3.41t/ha (cv Genesis 090) and 2.48 – 3.04t/ha (cv PBA Royal).*
- *Plant population had a significant effect on grain yield in chickpeas sown in mid-May, the highest yields being achieved with populations of approximately 30-34 plants/m2 (35-45 seeds/$m^2$)*
- *There were no significant yield differences between the two cultivars, although as observed in the earlier sowing the mean yield of Genesis 090 was higher than PBA Royal.*
- *The highest plant populations of 32 – 37 plants/m2 (based on 45 seeds/$m^2$) had significantly higher flowering dry matter than the lower populations (10 and 21 plants/$m^2$).*
- *The higher dry matters associated with higher populations correlated to faster ground cover and greater crop reflectance (recorded as NDVI) with significantly higher NDVIs up to mid flowering at which point there was no difference.*
- *Cultivar and plant population ad a significant impact on crop lodging; Genesis 090 recorded almost no lodging while PBA Royal recorded significantly more lodging, particularly at higher populations (28 and 32 plants/m2).*
- *The WUE of Genesis090 sown in May based on an average yield of 2.92t/ha was 10.3kg/mm.*



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 1.** Influence of seed rates (plant populations) on grain yield (t/ha) with two different varieties grown under overhead irrigation.

| | | Yield t/ha | | |
|---|---|---|---|---|
| **Plants/m² (actual)** | | **Genesis 090** | **PBA Royal** | **Mean** |
| **Genesis 090** | **PBA royal** | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** |
| 10 | 12 | 2.39 - | 2.48 - | **2.44 c** |
| 22 | 21 | 2.82 - | 2.83 - | **2.82 b** |
| 32 | 28 | 3.41 - | 3.04 - | **3.22 a** |
| 37 | 32 | 3.07 - | 2.98 - | **3.02 ab** |
| **Mean** | | **2.92 -** | **2.83 -** | |

| | | | |
|---|---|---|---|
| **LSD Cultivar p=0.05** | ns | **P val** | 0.598 |
| **LSD Seed Rate p = 0.05** | 0.32 | **P val** | <0.001 |
| **LSD Seed Rate x Cultivar.** | ns | **P val** | 0.482 |

**Table 2.** Influence of seed rate and cultivar on plant population – assessed at V7, 17-July.

| **Treatment** | **Plant Population** | | |
|---|---|---|---|
| | **Genesis 090** | **PBA Royal** | **Mean** |
| **Seed Rate** | **Plants/m²** | **Plants/m²** | **Plants/m²** |
| **15seeds/m²** | 10 - | 12 - | **11 c** |
| **25 seeds/m²** | 22 - | 21 - | **21 b** |
| **35 seeds/m²** | 32 - | 28 - | **30 a** |
| **45 seeds/m²** | 37 - | 32 - | **34 a** |
| **Mean** | 25 - | 23 - | |

| | | | |
|---|---|---|---|
| **Cultivar LSD** | ns | **P val** | 0.351 |
| **Seed Rate LSD** | 5.9 | **P val** | <0.001 |
| **LSD** | ns | **P val** | 0.533 |

**Table 3.** Influence of plant population and cultivar on canopy composition, pods/m² and height to first pod (cm) – assessed at harvest, 2-Dec.

| **Treatment** | **Canopy composition** | |
|---|---|---|
| **Cultivar and Population** | **Pods/m²** | **1st Pod Height (cm)** |
| **Genesis 090** | | |
| 32 plants/m² | 1320 - | 48 ab |
| **PBA Royal** | | |
| 12 plants/m² | 1019 - | 44 bc |
| 21 plants/m² | 1184 - | 41 c |
| 28 plants/m² | 1050 - | 49 a |
| 32 plants/m² | 1133 - | 47 ab |
| **Mean** | **1141** | **46** |

| | | |
|---|---|---|
| **LSD** | ns | 5.1 |
| **P val** | 0.263 | 0.026 |

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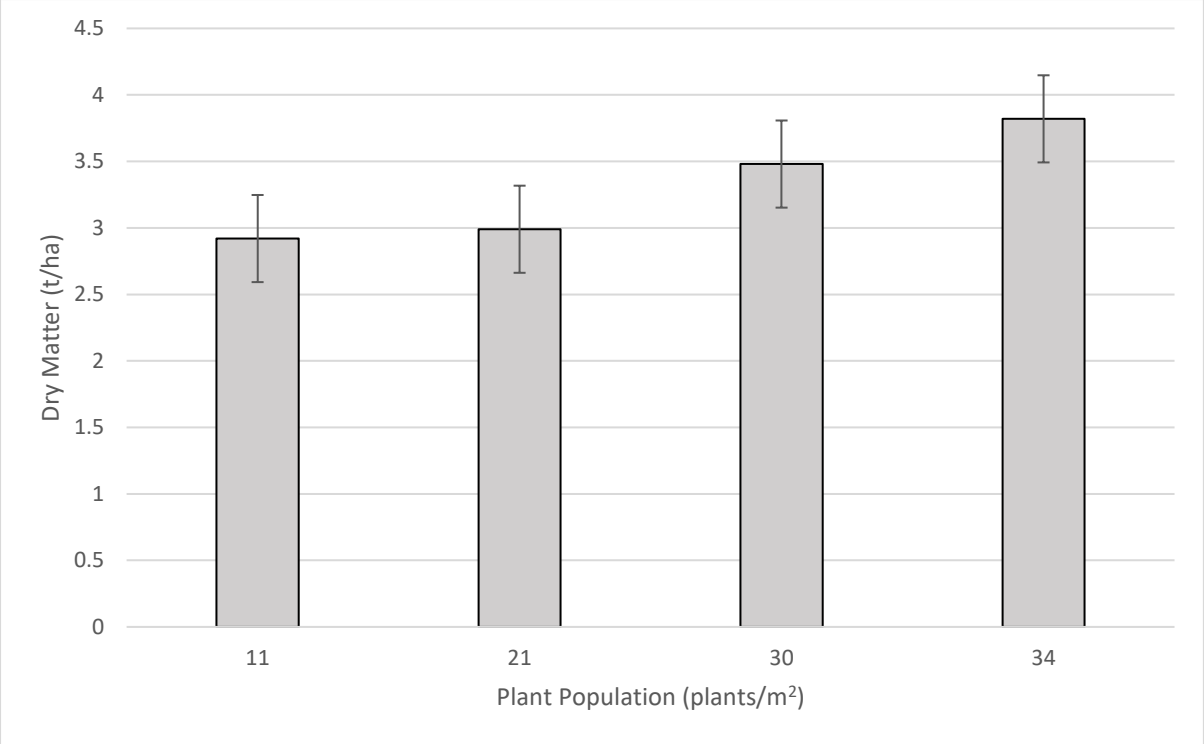


**Figure 1.** Influence of plant population (mean of two cultivars) on dry matter (t/ha) production at early flowering (R2) – Assessed 28-Sep.

**Table 3.** Influence of plant population (mean of two cultivars) on crop reflectance measured as normalised differential vegetation index (NDVI) (0-1) – assessed 28 July, 14 & 29 September and 15 October.

| **Treatment** | **Normalised differential vegetation index (NDVI)** | | | |
|---|---|---|---|---|
| **Plant Population** | **V9** | **V20** | **R2** | **R4** |
| | **28-Jul** | **14- Sep** | **29- Sep** | **15- Oct** |
| | **NDVI (0-1)** | **NDVI (0-1)** | **NDVI (0-1)** | **NDVI (0-1)** |
| 11 plants/m$^2$ | 0.16 c | 0.49 c | 0.70 b | 0.79 - |
| 21 plants /m$^2$ | 0.17 c | 0.61 b | 0.76 a | 0.79 - |
| 30 plants /m$^2$ | 0.19 b | 0.69 a | 0.77 a | 0.78 - |
| 34 plants /m$^2$ | 0.21 a | 0.71 a | 0.78 a | 0.79 - |
| **Mean** | **0.18** | **0.63** | **0.75** | **0.79** |
| **LSD** | 0.014 | 0.04 | 0.022 | ns |
| **P val** | <0.001 | <0.001 | <0.001 | 0.208 |



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**Table 4.** Influence of cultivar and plant population on crop lodging index score (0-500) (assessed RH 2-Dec).

| | Lodging Score | | |
|---|---|---|---|
| **Seedrate (Plants/m²)** | **Genesis 090** | **PBA Royal** | **Mean** |
| | **Score (0-500)** | **Score (0-500)** | **Score (0-500)** |
| **15seeds/m² (10,12)** | 0.0 b | 18.8 b | **9.4 b** |
| **25 seeds/m² (22,21)** | 0.0 b | 18.8 b | **9.4 b** |
| **35 seeds/m² (32,28)** | 2.5 b | 93.8 a | **48.1 a** |
| **45 seeds/m² (37,32)** | 0.0 b | 93.8 a | **46.9 a** |
| **Mean** | **0.6 b** | **56.3 a** | |

| | | | |
|---|---|---|---|
| **LSD Cultivar p=0.05** | 47.1 | **P val** | 0.033 |
| **LSD Seed Rate p = 0.05** | 14.0 | **P val** | <0.001 |
| **LSD Seed Rate x Cultivar.** | 19.8 | **P val** | <0.001 |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Trial 3 Disease Management Strategies for Chickpeas Grown Under Irrigation

**Project objective:** To assess the relative importance of fungicide input for Genesis 090 and PBA Monarch under overhead irrigation.

**Location:** Finley IRC
**FAR Code:** FAR CP20-07-1
**Sown:** 27 April
**Cultivar:** Genesis 090 and PBA Monarch
**Harvested:** 11th December 2020
**Rotation position:** Wheat (2019), Faba beans (2018), Fallow after Rice (2017)
**Soil Management:** Cultivation with speed disc to incorporate stubble in Autumn
**Irrigation:** Overhead lateral irrigation 6 x 25mm in spring. Total applied 150mm (1.5 ML/ha)
**GSR:** April-October 244mm. Total water available (GSR + Irr) 394mm

**Key Messages:**

- *Fungicide strategies for April sown chickpeas (mean of two cultivars) gave significant yield increases of 0.66t/ha (cheaper programme) and 0.98t/ha (more expensive programme) (mean of both cultivars) which represented a 26 & 38% increase in yield over the untreated.*
- *Disease levels, principally Ascochyta (Ascochyta rabiei) up to and including mid-flower were quite low (<1% leaf area infected LAI) and there were no differences due to cultivar or fungicide strategy.*
- *Genesis 090 had significantly more ascochyta infection 14 days after the last application of the 3rd fungicide at mid-flower than PBA Monarch, however this difference became insignificant 28 DAA.*
- *Both fungicide strategies gave significant improvements in control of ascochyta at 14 and 28 after the final application compared to nil control treatment and produced significant improvements in grain yield.*
- *There was no significant difference in ascochyta control however there was a significant difference in the subsequent grain yield between the 'cheap' and 'expensive' fungicide strategies.*
- *There was an increase in margin over input cost as a result of applying fungicide with the expensive fungicide treatment resulting in a higher return on investment compared to the cheap strategy.*
- *The WUE of the highest yielding Genesis 090 treated with an expensive fungicide strategy was 12.9kg/mm.*

**Table 1.** Fungicide treatment list.

| | | Treatment mL/ha | | |
|---|---|---|---|---|
| | **Strategy** | **4-6 Node V6 – 7-Jul** | **Pre-Flower V18 – 26-Aug** | **Mid-Flower R3 – 2-Oct** |
| **1.** | **Untreated** | - | - | - |
| **2.** | **Cheap** | Chlorothalonil 720 @ 1.4 L/ha | Chlorothalonil 720 @ 1.4 L/ha | Chlorothalonil 720 @ 1.4 L/ha |
| **3.** | **Expensive** | Veritas @ 1 L/ha | Aviator Xpro @ 600mL/ha | Veritas @ 1 L/ha |



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**Table 2.** Influence of fungicide strategy (based on three foliar sprays) on chickpea grain yield with 2 varieties.

| | | Grain Yield | | |
|---|---|---|---|---|
| | | Genesis 090 | PBA Monarch | Mean |
| | Treatment | Yield t/ha | Yield t/ha | Yield t/ha |
| 1. | Untreated | 2.51 - | 2.29 - | **2.40 c** |
| 2. | Cheap | 3.48 - | 2.97 - | **3.23 b** |
| 3. | Expensive | 3.67 - | 3.43 - | **3.55 a** |
| | Mean | **3.22 -** | **2.90 -** | |
| | | | | |
| **LSD Cultivar p=0.05** | | ns | **P val** | 0.095 |
| **LSD Fungicide p = 0.05** | | 0.37 | **P val** | <0.001 |
| **LSD Fungicide x Cultivar P=0.05** | | ns | **P val** | 0.620 |

**Table 3.** Influence of fungicide strategy (based on three foliar sprays) on margin over input cost ($/ha - value of increased grain production minus cost of inputs and application costs).

| Treatment | Total Fungicide Cost | Yield (t/ha) | Gross Income ($/ha) | Margin gain ($/ha) | Return on Investment |
|---|---|---|---|---|---|
| **Untreated** | Nil | 2.40 | $1392 | - | - |
| **Cheap** | $98 | 3.23 | $1873 | $384 | 3.9 |
| **Expensive** | $132 | 3.55 | $2059 | $535 | 4.1 |

*Input costs based on current chemical prices at 17/2/21 plus an application cost of $15/ha. Income based on current grain price of $615/t less $35 freight as of 17/2/21.*



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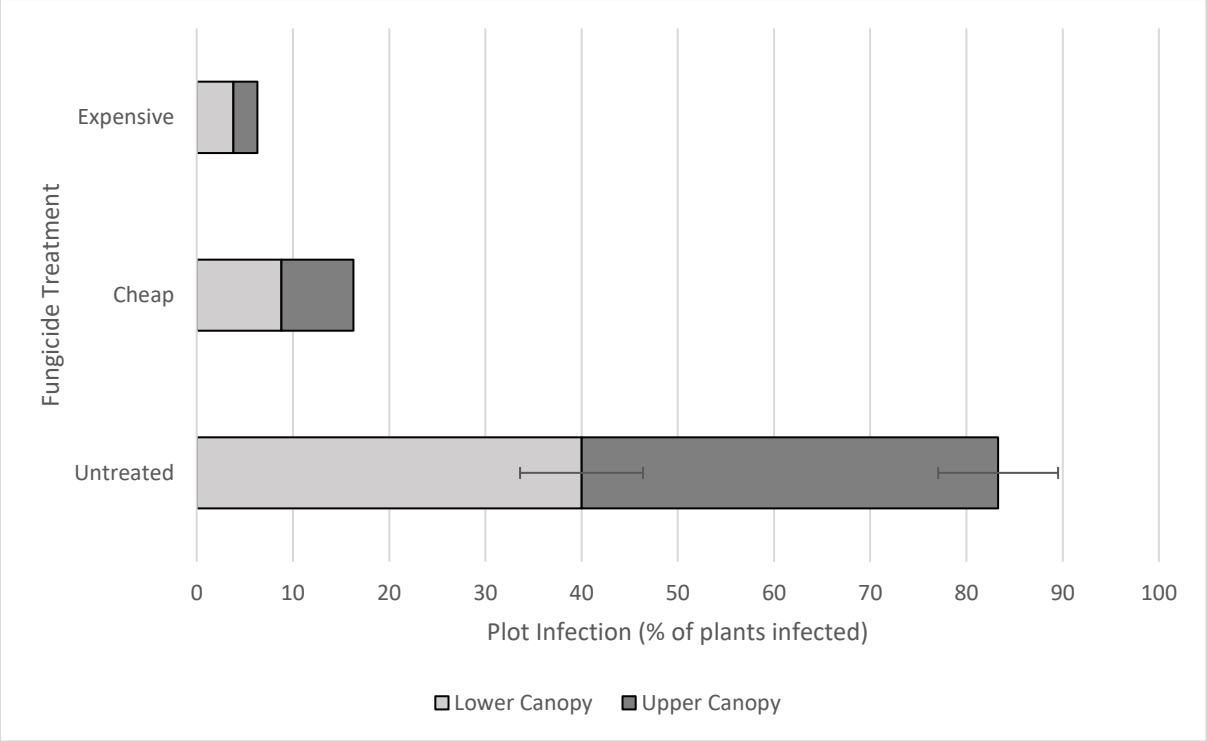


**Figure 1.** Influence of fungicide strategy on % Ascochyta infection (incidence) 14 days after 3rd fungicide application (15-Oct). Lower canopy P value – <0.001 LSD= 12.8, Upper canopy P value – <0.001 LSD= 12.7.

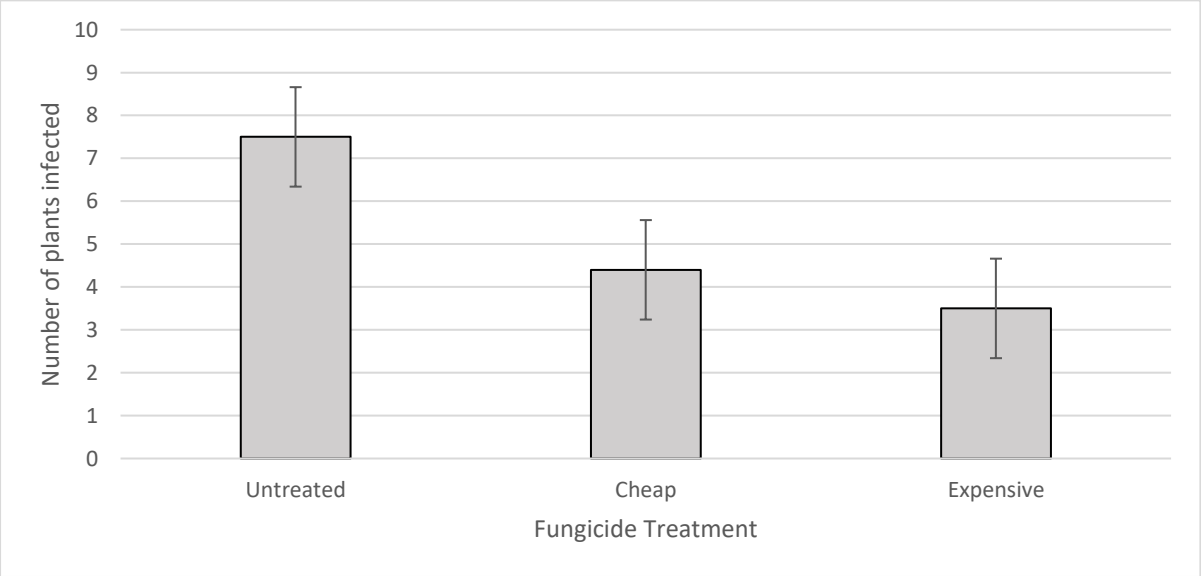


**Figure 2.** Influence of fungicide strategy on Sclerotinia infection (incidence) 14 days after 3rd fungicide application (15-Oct). P value – 0.007 LSD= 2.3.

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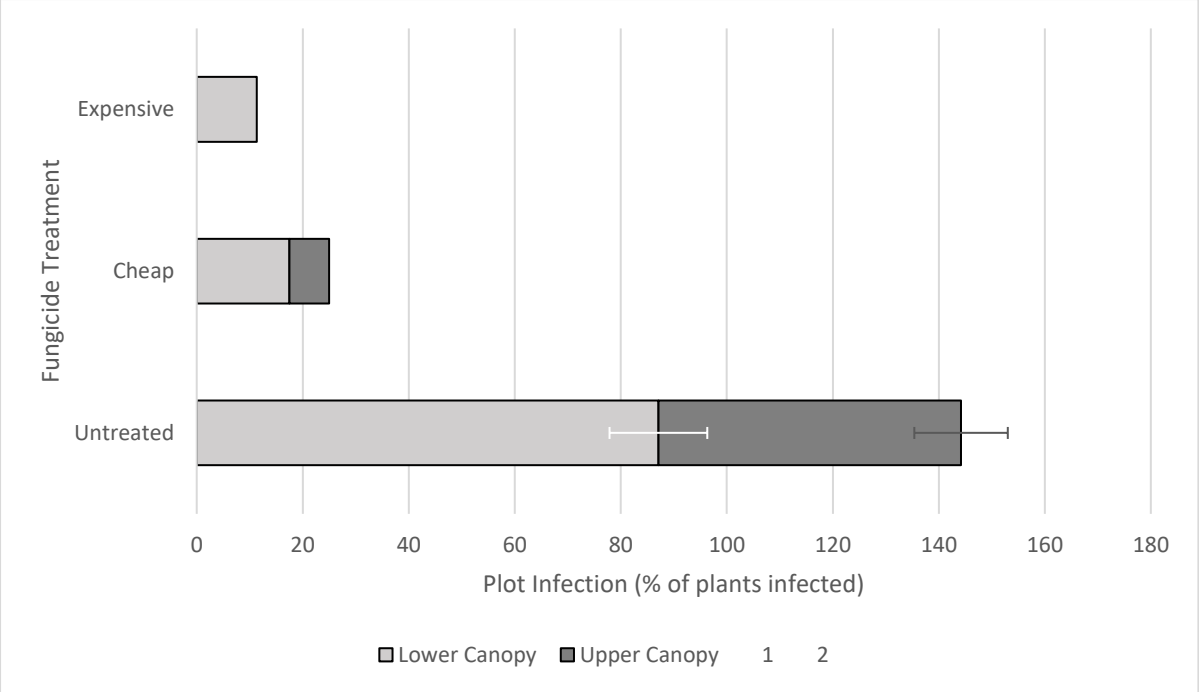


**Figure 3.** Influence of fungicide strategy on % Ascochyta infection (incidence) 28 days after 3rd fungicide application (5-Nov). Lower canopy P value <0.001, LSD= 18.4. Upper canopy P value <0.001, LSD= 17.6.

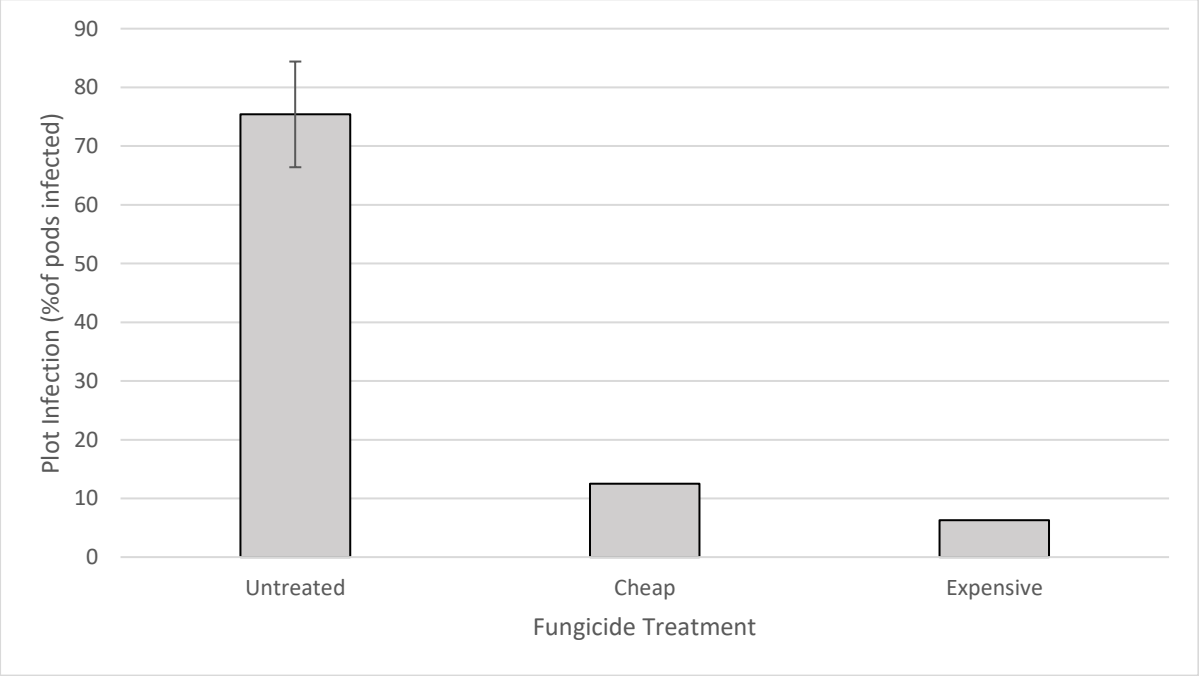


**Figure 4.** Influence of fungicide strategy on % Ascochyta infection of pods (incidence) 28 days after 3rd fungicide application (5-Nov). P value <0.001, LSD= 18.0.

Released:24 February 2021

The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

# Kerang VIC

*Irrigated trials conducted at the Kerang irrigated research centre 2020 were managed by the Irrigated Cropping Council*

## Trial 1 Influence of Rhizobium Inoculation on Chickpea Yield and Profitability

**Protocol Objective:**
To evaluate the influence of different rhizobium treatments on chickpea nodulation, dry matter, grain yield and profitability under flood irrigation.

**Location:** Kerang, Victoria
**FAR Code:** ICC CP20-05-1
**Sown:** 18 May 2020
**Cultivar:** PBA Royal
**Harvested:** 24 December 2020
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Flood irrigation 2 applications totalling 230mm (2.3 ML/ha)
**GSR:** April-October 250mm. Total water available 480mm

***Key Messages:***

- *Starting soil N levels were high (125 kg N/ha) due to the brown manured vetch phase prior to 2020.*
- *Chickpeas had not been grown in the trial location and inoculation did result in better nodulation of the chickpeas.*
- *Nodulation did improve with higher rates of granular inoculum.*
- *Yield and grain size were not influenced by the trial treatments, possibly due to the relatively high soil N and low reliance on fixed N for plant growth.*

**Table 1.** Nodulation Scores 11 weeks post sowing.

| Treatment | Nodulation Score |
|---|---|
| **Nil (Control)** | 0.6 c |
| **ALOSCA granules 10 kg/ha** | 2.7 b |
| **ALOSCA granules 20 kg/ha** | 3.0 ab |
| **ALOSCA granules 30 kg/ha80** | 3.3 a |
| **N applied at Sowing 40 kg N/ha** | 0.7 c |
| **N applied at Podding 40 kg N/ha** | 0.5 c |
| p = <0.001, lsd = 0.41, cv% = 15.2 | |

*Nodulation scoring as per the 2020 trials protocol methodology*
*Nodulation figures followed by different letters are considered to be statistically different (p=0.05)*

There was an improvement in nodulation as the rate of granule was increased.
However the higher rate of nodulation did not result in either higher biomass or grain yield.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 2.** Influence of inoculation on dry matter production at early flowering (21/9) and at harvest (24/12)

| Treatment | Early Flowering | Harvest |
|---|---|---|
| **Nil (Control)** | 4.00 | 10.97 |
| **ALOSCA granules 10 kg/ha** | 3.88 | 9.09 |
| **ALOSCA granules 20 kg/ha** | 3.95 | 11.95 |
| **ALOSCA granules 30 kg/ha** | 3.89 | 9.05 |
| **N applied at Sowing 40 kg N/ha** | 5.21 | 8.83 |
| **N applied at Podding 40 kg N/ha** | 4.62 | 11.5 |
| **P val** | 0.097 | 0.052 |
| **LSD** | NS | NS |
| **cv%** | 16.8 | 16.1 |

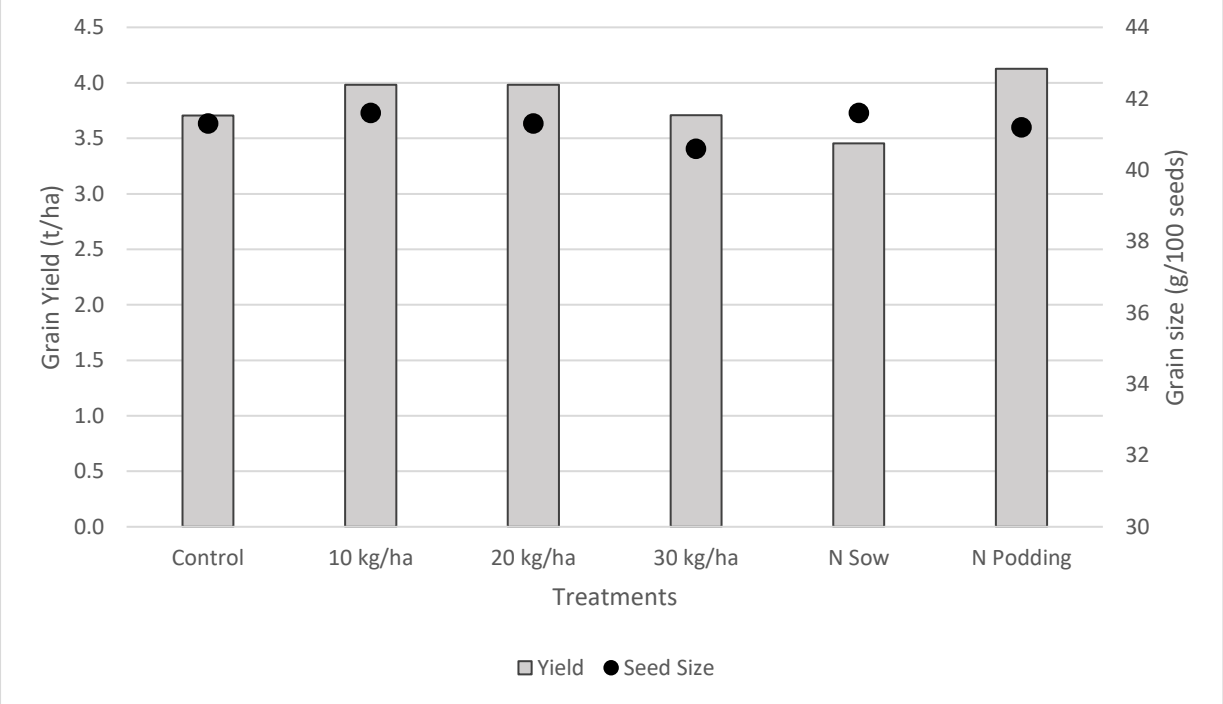


**Figure 1**. Influence of inoculation and N application on grain yield (t/ha) and grain size (g/100 seeds).
Grain Yield: p = 0.068, lsd = NS, cv% = 8.0, trial mean = 3.83 t/ha
Grain size: p = 0.362, lsd = NS, cv% = 1.7, trial mean = 41.3 g/100 seeds



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Trial 2 Influence of Chickpea Cultivation on Durum Wheat Yield and Profitability

**Protocol Objective:**
To evaluate the influence of top work cultivation (speed till) in chickpea stubble on durum wheat yield and profitability in 2021. In 2020 the trial evaluated plant population in the previous chickpea crop.

**Location:** Kerang, Victoria
**FAR Code:** ICC CP20-06-1
**Sown:** 12 May 2020
**Cultivar:** Genesis 090
**Harvested:** 24 December 2020
**Rotation position:** Dryland vetch/brown manured 2019
**Soil Type:** Neutral medium red clay, bordercheck.
**Irrigation:** Flood irrigation 3 applications totalling 290mm (2.9 ML/ha)
**GSR:** April-October 250mm. Total water available 540mm

***Key Messages:***

- *Chickpea establishment rate was approximately 60% at seedrates between 15 – 45 seeds/m$^2$.*
- *The higher the seeding rate and resultant plant population, the trend was for higher dry matter at harvest and grain yield.*
- *Harvest index averaged 0.35 and was not affected by seeding rate/plant population.*
- *Based on the highest yields achieved at 27plants/m2 (4.56t/ha) WUE was 10.6kg/mm.*

**Table 1.** Trial treatment summary.

| Trt. | Cultivation (2021) | Seed rate (Seeds/m2) (2020) |
|---|---|---|
| **1** | Direct drill | 15 seeds/m2 |
| **2** | Direct drill | 25 seeds/m2 |
| **3** | Direct drill | 35 seeds/m2 |
| **4** | Direct drill | 45 seeds/m2 |
| **5** | Speed Till | 15 seeds/m2 |
| **6** | Speed Till | 25 seeds/m2 |
| **7** | Speed Till | 35 seeds/m2 |
| **8** | Speed Till | 45 seeds/m2 |

**Table 2**. Canopy measurements – plant populations (plants/m2) and harvest dry matter (t/ha).

| Seeding rate | Plant population | Dry matter |
|---|---|---|
| **15 seeds/m$^2$** | 8.8 d | 9.13 c |
| **25 seeds/m$^2$** | 15.0 c | 10.03 bc |
| **35 seeds/m$^2$** | 21.5 b | 10.92 ab |
| **45 seeds/m$^2$** | 26.8 a | 11.66 a |
| P val | <0.001 | 0.019 |
| LSD | 1.68 | 1.617 |
| cv% | 11.2 | 18.6 |

Plant establishment was approximately 60% across the four seedrates evaluated (Table 2).
Dry matter was highest in the high seeding rate treatments that established 27plants/m$^2$.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

NDVI measurement during the season revealed differences between the canopies of each treatment, but there was no significant difference when measured on 11 September.

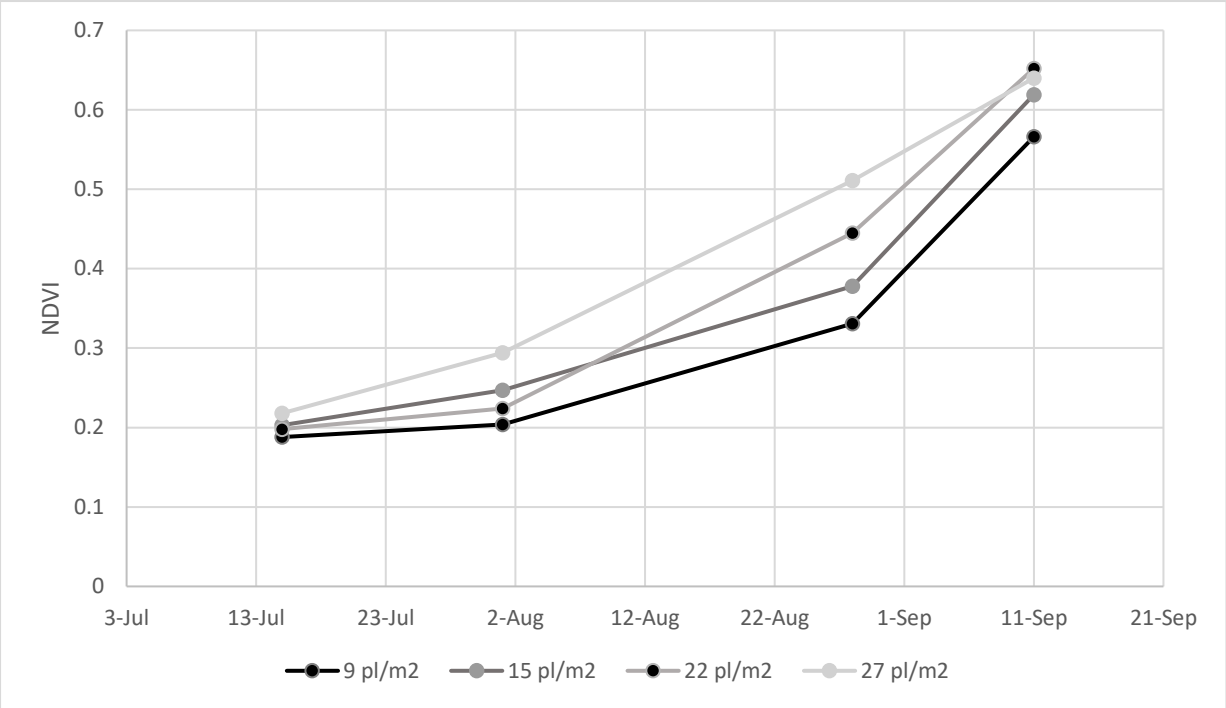


**Figure 1**. Influence of plant population on crop reflectance measured as NDVI (0 – 1 scale).

**Table 3.** Chickpea yield (t/ha) and grain size (g/100 seeds) and harvest index.

| Seeding rate | Yield (t/ha) | Seed size | Harvest Index |
|---|---|---|---|
| **15 seeds/m²** | 3.44 c | 30.5 | 0.35 |
| **25 seeds/m²** | 3.76 bc | 30.8 | 0.34 |
| **35 seeds/m²** | 4.05 b | 30.9 | 0.34 |
| **45 seeds/m²** | 4.56 a | 31.2 | 0.36 |
| P val | <0.001 | 0.637 | 0.508 |
| LSD | 0.47 | NS | NS |
| cv% | 14.4 | 4.5 | 10.1 |

Grain yield mirrored seeding rate/plant population, with the highest yields achieved by the 45 seeds/m2 seeding rate treatment which established 27 plants/$m^2$.
Plant population between 9 – 27 plants/$m^2$ did not influence either seed size or harvest index.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Trial 3 Disease Management Strategies for Chickpeas Grown Under Irrigation

**Protocol Objective:**
To evaluate the economics of disease management strategies of different costs in irrigated chickpea production.

**Location:** Kerang, Victoria
**Sown:** 18 May 2020
**Harvested:** 24 December 2020
**FAR Code:** ICC CP20-07-2
**Cultivar:** PBA Monarch and Genesis 090
**Rotation position:** Dryland vetch/brown manured 2019
**Soil Type:** Neutral medium grey clay, bordercheck.
**Irrigation:** Flood irrigation 2 applications totalling 210mm (2.1 ML/ha)
**GSR:** April-October 250mm. Total water available 460mm

***Key Messages:***

- *Yield of each variety was not influenced by the fungicide strategy.*
- *Seed size was increased in PBA Monarch only as a result of the 'cheap' strategy.*
- *Variety selection did result in differences in grain yield and size.*
- *Although the growing season was above average, much of this rainfall was prior to sowing. The winter period tended to be drier than average, resulting in conditions that did not favour disease. Coupled with the relatively few local crops, disease pressure was low and very little disease was evident in the trial.*
- *Neither the older Genesis 090 nor the new release PBA Monarch showed any differences in foliar disease expression given there was minimal disease pressure.*
- *Random plants across the trial did succumb to root rot prior to flowering.*

**Table 1.** Trial treatment summary.

| TRT | Variety | Management Strategy | 4-5 weeks post emergence | Pre-Flower | Late Flower |
|---|---|---|---|---|---|
| **1** | Genesis 090 | Untreated* | - | - | - |
| **2** | Genesis 090 | Cheap | Chlorothalonil 720 1 l/ha | Chlorothalonil 720 1 l/ha | Chlorothalonil 720 1 l/ha |
| **3** | Genesis 090 | Expensive | Veritas 1l/ha | Aviator Xpro 600ml/ha | Veritas 1l/ha |
| **4** | PBA Monarch | Untreated* | - | - | - |
| **5** | PBA Monarch | Cheap | Chlorothalonil 720 1 l/ha | Chlorothalonil 720 1 l/ha | Chlorothalonil 720 1 l/ha |
| **6** | PBA Monarch | Expensive | Veritas 1l/ha | Aviator Xpro 600ml/ha | Veritas 1l/ha |

The plant canopy was assessed for disease prior to each fungicide application. Very low levels of foliar disease was recorded at the early podding stage of the trial in the lower canopy irrespective of fungicide treatment. Disease did not progress up the canopy as the season continued.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 2.** Chickpea yield (t/ha) and grain size (g/100 seeds).

| | Grain Yield | | Grain Size | |
|---|---|---|---|---|
| **Treatment** | PBA Monarch | Genesis 090 | PBA Monarch | Genesis 090 |
| **Untreated (Control)** | 3.37 - | 4.17 - | 40.3 - | 30.9 - |
| **'Cheap'** | 3.52 - | 4.88 - | 41.8 - | 31.5 - |
| **Expensive** | 3.60 - | 4.53 - | 40.7 - | 31.8 - |
| **Mean** | **3.50 b** | **4.53 a** | **40.9 a** | **31.4 b** |
| Yield: $p_{var}$ = <0.001, $p_{fung}$ = 0.256 $p_{vxf}$ = 0.516, $lsd_{var}$ = 0.441, $lsd_{fung}$ = NS $lsd_{vxf}$ = 0.76, cv% = 12.6 | | | | |
| Grain size: $p_{var}$ = <0.001, $p_{fung}$ = 0.089, $p_{vxf}$ = 0.516, $lsd_{var}$ = 0.783, $lsd_{fung}$ = NS $lsd_{vxf}$ = 1.36, cv% = 2.5 | | | | |

The trial mean yield was 3.8 t/ha. WUE was 9.3 kg/mm.

Released:24 February 2021

# Griffith NSW

*Irrigated trials conducted at the Griffith irrigated research centre 2020 were managed by the Irrigated Cropping Council in collaboration with IREC*

## Trial 1 Influence of Rhizobium Inoculation on Chickpea Yield and Profitability

**Protocol Objective:**
To evaluate the influence of different rhizobium treatments on chickpea nodulation, dry matter, grain yield and profitability under irrigation.

**Location:** Whitton, NSW
**Sown:** 29 May 2020
**Harvested:** 22 December 2020
**Rotation position:** Cotton 19/20
**Soil Type:** Neutral red clay loam, 150 cm beds
**Irrigation:** Nil
**GSR:** April-October 297mm

**FAR Code:** ICC CP20-05-2
**Cultivar:** PBA Royal

***Key Messages:***

- *Starting soil N levels were 85 kg N/ha (0-60 cm) at sowing.*
- *Chickpeas had been grown in the trial location 5 years prior, and all treatments did have nodules when assessed 10 weeks after sowing.*
- *The higher inoculum rates of 20 and 30 kg/ha did result in higher nodulation scores than that of the untreated control.*
- *Yield and grain size were not influenced by the trial treatments.*

**Table 1.** Nodulation Scores 10 weeks post sowing.

| Treatment | Nodulation Score | |
|---|---|---|
| **Nil (Control)** | 2.15 | b |
| **ALOSCA granules 10 kg/ha** | 2.65 | ab |
| **ALOSCA granules 20 kg/ha** | 2.80 | a |
| **ALOSCA granules 30 kg/ha80** | 3.0 | a |
| **N applied at Sowing 40 kg N/ha** | 1.85 | b |
| **N applied at Podding 40 kg N/ha** | 1.93 | b |
| p = 0.004, lsd = 0.61, cv% = 16.9 | | |

*Nodulation scoring as per the 2020 trials protocol methodology*
*Nodulation figures followed by different letters are considered to be statistically different (p=0.05)*

There was an improvement in nodulation as the rate of granule was increased.
However the higher rate of nodulation did not result in either higher biomass or grain yield.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 2.** Influence of inoculation on dry matter production at early flowering (21/9) and at harvest (24/12).

| Treatment | Early Flowering | Harvest |
|---|---|---|
| **Nil (Control)** | 2.15 b | 5.05 |
| **ALOSCA granules 10 kg/ha** | 2.65 ab | 5.07 |
| **ALOSCA granules 20 kg/ha** | 2.80 a | 5.40 |
| **ALOSCA granules 30 kg/ha** | 3.00 a | 5.40 |
| **N applied at Sowing 40 kg N/ha** | 1.85 b | 4.79 |
| **N applied at Podding 40 kg N/ha** | 1.93 b | 5.18 |
| **P val** | 0.004 | 0.614 |
| **LSD** | 0.612 | NS |
| **cv%** | 16.9 | 10.6 |


**Figure 1**. Grain yield (t/ha) and grain size (g/100 seeds).
Grain Yield: p = 0.795, lsd = NS, cv% = 13.3, trial mean = 2.02 t/ha
Grain size: p = 0.770, lsd = NS, cv% = 4.1, trial mean = 41.2 g/100 seeds

The trial was planned to be irrigated but well-above average April rainfall (106mm) on the back of a summer crop and predictions of a wetter season discouraged the co-operator from pre-irrigation. He decided the spring rainfall was sufficient, therefore unnecessary for any spring irrigation.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Trial 2 Disease Management Strategies for Chickpea Growth Under Irrigation

**Protocol Objective:**
To evaluate the economics of disease management strategies of different costs in irrigated chickpea production.

**Location:** Whitton, NSW
**Sown:** 29 May 2020 PBA Monarch and Genesis 090
**Harvested:** 22 December 2020
**Rotation position:** Cotton 19/20
**Soil Type:** Neutral red clay loam, 150 cm beds
**Irrigation:** Nil
**GSR:** April-October 297mm

**FAR Code:** ICC CP20-07-3
**Cultivar:** PBA Monarch and Genesis 090

***Key Messages:***

- *Yield and was not influenced by the trial treatments, neither fungicide strategy nor variety selection.*
- *Variety selection did result in a larger grain size.*
- *Although the growing season was above average, much of this rainfall was prior to sowing. The winter period tended to be drier than average, resulting in conditions that did not favour disease. Coupled with the relatively few local crops, disease pressure was low and very little disease was evident in the trial.*
- *Neither the older Genesis 090 nor the new release PBA Monarch showed any differences in disease expression given there was minimal disease pressure.*
- *Overall yields were suppressed by the co-operators decision to not irrigate in early spring.*

**Table 1:** Trial treatment summary.

| TRT | Variety | Management Strategy | 4-5 weeks post emergence | Pre-Flower | Late Flower |
|---|---|---|---|---|---|
| **1** | Genesis 090 | Untreated* | - | - | - |
| **2** | Genesis 090 | Cheap | Chlorothalonil 720 1 l/ha | Chlorothalonil 720 1 l/ha | Chlorothalonil 720 1 l/ha |
| **3** | Genesis 090 | Expensive | Veritas 1l/ha | Aviator Xpro 600ml/ha | Veritas 1l/ha |
| **4** | PBA Monarch | Untreated* | - | - | - |
| **5** | PBA Monarch | Cheap | Chlorothalonil 720 1 l/ha | Chlorothalonil 720 1 l/ha | Chlorothalonil 720 1 l/ha |
| **6** | PBA Monarch | Expensive | Veritas 1l/ha | Aviator Xpro 600ml/ha | Veritas 1l/ha |

** Untreated received a fungicide application as part of a herbicide application on July 15 by the co-operator*

The plant canopy was assessed for disease prior to each fungicide application. No foliar disease was recorded at any stage of the trial.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 2.** Chickpea yield (t/ha) and grain size (g/100 seeds).

| | Grain Yield | | Grain Size | |
|---|---|---|---|---|
| **Treatment** | PBA Monarch | Genesis 090 | PBA Monarch | Genesis 090 |
| **Untreated (Control)** | 1.82 | 1.90 | 40.5 a | 32.7 b |
| **'Cheap'** | 1.96 | 1.96 | 40.8 a | 33.2 b |
| **Expensive** | 2.11 | 1.84 | 40.5 a | 32.5 b |
| **Mean** | 1.9 - | 1.90 - | 40.6 a | 32.8 b |
| Yield: $p_{var}$ = 0.427, $p_{fung}$ = 0.458 $p_{vxf}$ = 0.207, $lsd_{vxf}$ = NS, cv% = 10.1 | | | | |
| Grain size: $p_{var}$ = <0.001, $p_{fung}$ = 0.784, $p_{vxf}$ = 0.570, $lsd_{vxf}$ = 2.45, cv% = 10.1 | | | | |

Trial mean yield was 1.9 t/ha. WUE was 6.5 kg/mm (excluding soil moisture at sowing).

The trial was planned to be irrigated but well-above average April rainfall (106mm) on the back of a summer crop and predictions of a wetter season discouraged the co-operator from pre-irrigation. He decided the spring rainfall was sufficient, therefore unnecessary for any spring irrigation.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

Optimising Irrigated Grains

# Optimising Irrigated Grains (FAR1906-003RTX)

**A Grains Research & Development Corporation (GRDC) investment**

## PROVISIONAL HARVEST RESULTS:

# Irrigated Durum Wheat Trials

Released:24 February 2021

The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

# Finley Irrigated Research Centre NSW

*Irrigated trials conducted at the Finley irrigated research centre 2020 were managed by FAR Australia, hosted by Southern Growers.*

## Trial 1 Optimum Plant Population Under Overhead Irrigation

**Protocol objective:** Assess the performance of durum grown at different plant populations under overhead irrigation

**Location:** Finley IRC
**FAR Code:** FAR D20-01-1
**Sown:** 19 May
**Cultivar:** DBA Aurora and DBA Vittaroi
**Harvested:** 29th November 2020
**Rotation position:** Fallow (2019), Faba beans (2018), Wheat (2017)
**Soil Management:** Cultivation with speed disc in Autumn
**Irrigation:** Overhead lateral Irrigation 5 x 25mm in spring. Total applied 125mm (1.25 ML/ha)
**GSR:** April-October 244mm. Total water available 369mm

**Key Messages:**

- *In a first wheat scenario following fallow in 2019 durum wheat yielded between 7.07 - 7.52t/ha with no significant difference in yield due to variety (DBA Aurora and DBA Vittaroi).*
- *With 19 May sowing there was no difference in yield from plant populations that varied from approximately 100 – 300 plants/m$^2$, although 150 - 200 plants/m$^2$ were associated with the highest yields in both varieties.*
- *As plant population increased with DBA Aurora it was associated with significantly more lodging. There was no lodging in DBA Vittaroi irrespective of plant population.*
- *There was significantly more tiller production at the highest plant populations tested (525-660 tillers/m$^2$ but it had no significant yield benefit in either cultivar.*
- *In DBA Aurora there was no significant difference in head numbers as a result of increasing plant population, although the trend suggested lower head numbers with lower populations.*
- *Although increasing plant population significantly increased dry matter production at pseudo stem erect (GS30) lower plant populations had compensated such that there was no difference when assessed at the start of grain fill (GS71) and harvest.*
- *Plant population had no significant effect on grain protein (range 13.4-14.5%) which averaged 13.9%*
- *DBA Aurora at 13.5% had significantly less grain protein than DBA Vittaroi at 14.3%.*

Durum wheat sown on 19 May produced yields of approximately 7 – 7.5t/ha (Table 1). Despite the production of higher biomass and tiller numbers earlier in the spring there was no significant difference in yield as a result of populations between approximately 100 – 300plants/m$^2$ (Table 2 & 3). Lodging during grain fill significantly increased with higher plant populations when growing DBA Aurora (Table 4).



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 1.** Influence of seed rates (plant population) on grain yield (t/ha) with two different varieties grown under overhead irrigation.

| | | *Yield* | | | *Protein* | | |
|---|---|---|---|---|---|---|---|
| **Plants/m² (actual)** | | **Aurora** | ***Vittaroi*** | ***Mean*** | ***Aurora*** | ***Vittaroi*** | ***Mean*** |
| **Aurora** | **Vittaroi** | **t/ha** | ***t/ha*** | ***t/ha*** | ***%*** | ***%*** | ***%*** |
| 110 | 90 | 7.04 - | *7.07* - | **7.06** - | *13.4* - | *14.2* - | **13.8** - |
| 166 | 178 | 7.30 - | *7.25* - | **7.27** - | *13.5* - | *14.3* - | **13.9** - |
| 191 | 231 | 7.52 - | *7.13* - | **7.32** - | *13.5* - | *14.5* - | **14.0** - |
| 322 | 308 | 7.23 - | *7.10* - | **7.16** - | *13.5* - | *14.1* - | **13.8** - |
| **Mean** | | **7.27** - | ***7.14*** - | | ***13.5*** ***b*** | ***14.3*** ***a*** | |

| | | |
|---|---|---|
| **LSD Cultivar p=0.05** | ns | 0.39 |
| **P val** | 0.175 | 0.007 |
| **LSD Seed Rate p=0.05** | ns | ns |
| **P val** | 0.221 | 0.303 |
| **LSD Seed Rate x Cultivar. P=0.05** | ns | ns |
| **P val** | 0.441 | 0.421 |

**Table 2.** Influence of plant population on canopy composition, plants/m² (GS21), tillers/m² (GS31) and heads/m² (GS87) – assessed GS21 (29 Jun), GS31 (13 Aug), GS87 (20 Nov).

| **Treatment** | **Canopy composition** | | |
|---|---|---|---|
| | Plants/m² | Tillers/m² | Heads/m² |
| **DBA Aurora** | | | |
| 100 seeds/m² | 110 - | 510 bc | 345 - |
| 200 seeds/m² | 166 - | 537 b | 387 - |
| 300 seeds/m² | 191 - | 552 b | 441 - |
| 400 seeds/m² | 322 - | 661 a | 447 - |
| **DBA Vittaroi** | | | |
| 100 seeds/m² | 90 - | 333 d | |
| 200 seeds/m² | 178 - | 442 c | |
| 300 seeds/m² | 231 - | 535 b | |
| 400 seeds/m² | 308 - | 526 b | |
| **Mean** | **200** | **512** | **405** |
| | | | |
| **LSD Seed Rate x Cultivar. P=0.05** | ns | 73 | 79 |
| **P val** | 0.104 | 0.028 | 0.052 |

In depth assessment of DBA Aurora showed that high plant populations produce significantly more vegetative biomass up to GS30 but whilst the trend continued at later growth stages the differences were not statistically significant (Figure 1).



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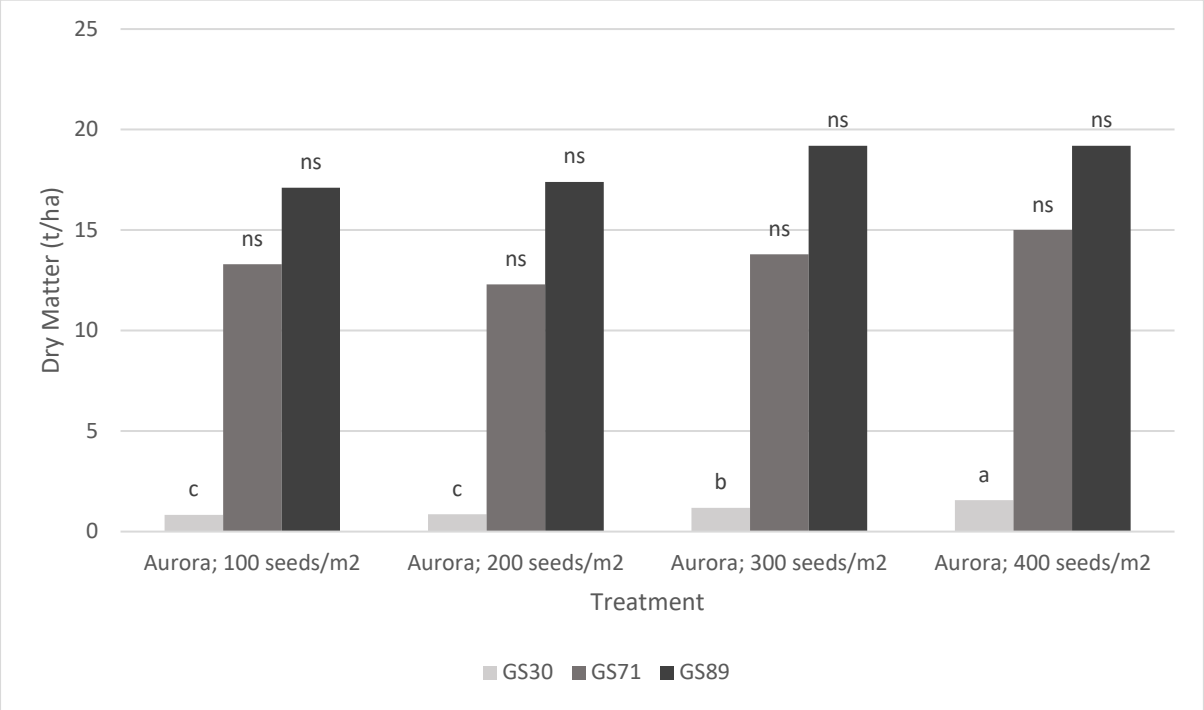


**Figure 1.** Influence of plant population on dry matter production (t/ha) at GS30, GS71 and harvest - assessed 31 July, 13 Oct, 20 Nov – cv DBA Aurora. GS30 P value=<0.001, LSD=0.22. GS71 P value=0.272. GS89 P value=0.211.

**Table 3.** Influence of plant population on crop lodging assessed by combining severity and % plot lodged on 0 – 500 scale at grain fill GS80, GS87 and harvest – (4 Nov, 17 Nov, 29 Nov)

| **Treatment** | **Lodging Score (0-500)** | | |
|---|---|---|---|
| | **GS80** | **GS87** | **Harvest** |
| **DBA Aurora** | | | |
| 110 plants/m$^2$ | 0 - | 11 - | 39 c |
| 166 plants/m$^2$ | 4 - | 79 - | 114 b |
| 191 plants/m$^2$ | 33 - | 115 - | 171 b |
| 322 plants/m$^2$ | 22 - | 183 - | 244 a |
| **DBA Vittaroi** | | | |
| 90 plants/m$^2$ | 0 - | 0 - | 0 c |
| 178 plants/m$^2$ | 0 - | 0 - | 0 c |
| 231 plants/m$^2$ | 0 - | 0 - | 0 c |
| 308 plants/m$^2$ | 0 - | 0 - | 0 c |
| **Mean** | **7** | **49** | **71** |
| **LSD Seed Rate x Cultivar. P=0.05** | 36 | 90 | 63 |
| **P val** | 0.526 | 0.071 | 0.001 |

Released:24 February 2021

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## Trial 2 Optimum Plant Population Under Flood Irrigation

**Protocol objective:** Assess the performance of durum grown at different plant populations under flood irrigation

**Location:** Finley IRC
**FAR Code:** FAR D20-01-2
**Sown:** 19 May
**Cultivar:** DBA Aurora and DBA Vittaroi
**Harvested:** 29th November 2020
**Rotation position:** Fallow (2019), Faba beans (2018), Wheat (2017)
**Soil Management:** Cultivation with speed disc in Autumn
**Irrigation:** Flood Irrigation 3 x 80mm in spring. Total applied 240mm (2.4 ML/ha)
**GSR:** April-October 244mm. Total water available 484mm

**Key Messages:**

- *In an identical trial to Trial 1 under flood bay irrigation DBA Aurora lodged severely and was significantly lower yielding than DBA Vittaroi.*
- *Though not statistically comparable (separate trials based on same site, same sowing date & management) yields were similar under overhead and flood irrigation but lodging at harvest was noted to be more severe where flood irrigation was used.*
- *DBA Aurora lodged significantly more at higher plant populations (150-300 plants/$m^2$) and was noted to start lodging earlier in grain fill (GS71). At harvest all plots of the variety had lodged irrespective of plant population.*
- *In contrast, lower levels of lodging were observed with DBA Vittaroi through grain fill, but yield trends suggested high plant populations were not advantageous.*
- *Lower plant populations were associated with lower dry matter production at early stem elongation (GS31) but later in the growing season there were no significant dufferences.*
- *Neither plant population or variety had any significant effect on grain protein (range 13.4-13.7%) which averaged 13.6%.*

Higher plant populations, tiller numbers and early dry matter production resulting from higher plant populations grown under flood irrigation produced no yield advantage (Table 1).



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 1.** Influence of seed rates (plant population) on grain yield (t/ha) with two different varieties grown with flood irrigation.

| | | Yield t/ha | | | Protein | | |
|---|---|---|---|---|---|---|---|
| **Plants/m2 (actual)** | | **Aurora** | **Vittaroi** | **Mean** | **Aurora** | **Vittaroi** | **Mean** |
| **Aurora** | **Vittaroi** | **t/ha** | **t/ha** | **t/ha** | **%** | **%** | **%** |
| 90 | 86 | 7.01 - | 8.20 - | **7.6 a** | 13.6 - | 13.6 - | **13.6 -** |
| 161 | 183 | 6.93 - | 7.73 - | **7.3 ab** | 13.4 - | 13.8 - | **13.6 -** |
| 240 | 230 | 6.54 - | 7.60 - | **7.0 bc** | 13.4 - | 13.8 - | **13.6 -** |
| 282 | 315 | 6.46 - | 7.21 - | **6.8 c** | 13.4 - | 13.6 - | **13.5 -** |
| **Mean** | | **6.73 b** | **7.69 a** | | **13.4 -** | **13.7 -** | |

| | | |
|---|---|---|
| **LSD Seed Rate p = 0.05** | 0.44 | ns |
| **P val** | 0.011 | 0.752 |
| **LSD Cultivar p=0.05** | 0.67 | ns |
| **P val** | 0.021 | 0.270 |
| **LSD Seed Rate x Cultivar. P=0.05** | ns | ns |
| **P val** | 0.692 | 0.390 |

**Table 2.** Influence of plant population and variety on canopy composition, plants/$m^2$ (GS21), tillers/$m^2$ (GS31) and heads/$m^2$ (GS87) – assessed GS21 (29 Jun), GS31 (13 Aug), GS87 (24 Nov).

| **Treatment** | **Canopy composition ($m^2$)** | | |
|---|---|---|---|
| | Plants/$m^2$ | Tillers/$m^2$ | Heads/$m^2$ |
| **DBA Aurora** | | | |
| 90 plants/$m^2$ | 90 - | 588 c | 420 - |
| 161 plants/$m^2$ | 161 - | 693 b | 451 - |
| 240 plants/$m^2$ | 240 - | 786 a | 468 - |
| 282 plants/$m^2$ | 282 - | 829 a | 468 - |
| **DBA Vittaroi** | | | |
| 86 plants/$m^2$ | 86 - | 385 d | |
| 183 plants/$m^2$ | 183 - | 642 bc | |
| 230 plants/$m^2$ | 230 - | 639 bc | |
| 315 plants/$m^2$ | 315 - | 680 b | |
| **Mean** | **198** | **655** | **452** |
| | | | |
| **LSD Seed Rate x Cultivar. P=0.05** | ns | 62 | ns |
| **P val** | 0.455 | 0.014 | 0.410 |

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**Table 3.** Influence of plant population on dry matter production (kg/ha) at pseudo stem erect (GS30), watery ripe (GS71) and crop maturity (GS87) - assessed GS30 (31 July), GS71 (13 Oct), GS87 (24 Nov) cv. DBA Aurora.

| Treatment | Dry Matter Production (kg/ha) | | |
|---|---|---|---|
| | GS30 | GS71 | GS87 |
| 90 plants/m$^2$ | 0.62 b | 13.14 - | 18.36 - |
| 161 plants/m$^2$ | 0.91 b | 14.25 - | 17.66 - |
| 240 plants/m$^2$ | 1.31 a | 14.10 - | 15.99 - |
| 282 plants/m$^2$ | 1.41 a | 13.98 - | 19.05 - |
| **Mean** | **1.06** | **13.9** | **17.76** |
| **LSD Seed Rate P=0.05** | 0.343 | ns | ns |
| **P val** | 0.002 | 0.5121 | 0.1746 |

**Table 4.** Influence of plant population on crop lodging assessed during grain fill GS71, GS80 and at harvest – (15 Oct, 4 Nov and 29 Nov respectively).

| Treatment | Lodging Score (0-500) | | |
|---|---|---|---|
| | GS71 | GS80 | Harvest |
| **DBA Aurora** | | | |
| 90 plants/m$^2$ | 11 d | 179 c | 326 - |
| 161 plants/m$^2$ | 86 ab | 304 ab | 413 - |
| 240 plants/m$^2$ | 68 bc | 280 b | 396 - |
| 282 plants/m$^2$ | 125 a | 364 a | 445 - |
| **DBA Vittaroi** | | | |
| 86 plants/m$^2$ | 0 d | 0 d | 15 - |
| 183 plants/m$^2$ | 26 cd | 38 d | 83 - |
| 230 plants/m$^2$ | 33 cd | 41 d | 73 - |
| 315 plants/m$^2$ | 15 d | 39 d | 74 - |
| **Mean** | **46** | **156** | **228** |
| **LSD** | 49 | 63 | ns |
| **P val** | 0.046 | 0.021 | 0.605 |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Trial 3 Nitrogen Use Efficiency Trial – Nitrogen Rates

**Project Objective:** To assess the impact of nitrogen (N) rate on durum wheat under overhead irrigation.

**Location:** Finley IRC
**FAR Code:** FAR D20-03-1
**Sown:** 19 May
**Cultivar:** DBA Vittaroi
**Harvested:** 29th November 2020
**Rotation position:** Fallow (2019), Faba beans (2018), Wheat (2017)
**Soil Management:** Cultivation with speed disc in Autumn
**Irrigation:** Overhead lateral Irrigation 5 x 25mm in spring. Total applied 125mm (1.25 ML/ha)
**GSR:** April-October 244mm. Total water available 369mm

**Key Messages:**

- *Deep soil N cores taken prior to sowing revealed approximately 100kg N/ha in the top 30cm and 232kg N/ha in a profile as a whole (0 - 90cm) following fallow in 2019.*
- *With this level of fertility under overhead irrigation DBA Vittaroi gave no significant yield response to N fertiliser at levels between 0 – 350kg N/ha with yields ranging from 6.93 – 7.43t/ha.*
- *Grain protein content was significantly increased by stem elongation N application up to a level of 150kg N/ha applied, moving protein from 13% to 14.5%.*
- *Above 150 kg N/ha applied there was no effect of increasing N input on grain protein.*
- *Nitrogen application rate had no significant effect on dry matter (DM) production assessed at harvest with an average DM of 16.6t/ha (range 15.96 – 17.97t/ha).*
- *Applying nitrogen at GS39 had no significant effect on grain protein and the small lift in grain yield (recorded at 300kg N/ha) was not statistically significant.*
- *Nitrogen offtake in the crop canopy varied from 246 – 384kg N/ha as applied N increased, this trend was strong but not significant (p=0.07).*
- *The unfertilised crop removed 264kgN/ha in the canopy indicating an additional 32 kg N/ha supplied through mineralisation (232kg N/ha at sowing).*
- *There was no significant difference in harvest index (proportion of DM harvested as grain) due to nitrogen rate.*

In a scenario of high soil fertility increasing applied N rates (Urea 46% N) from 0 – 350 kg N/ha had no significant effect on grain yield but was noted to increase grain protein up to 150 kg N/ha applied (Table 1).



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 1.** Influence of applied nitrogen rate at stem elongation on Grain yield (t/ha) and Protein content (%).

| | Application Timing | | | | Grain yield and quality | | |
|---|---|---|---|---|---|---|---|
| | GS30 Kg N/ha | GS32 Kg N/ha | GS39 Kg N/ha | Total kg N/ha | Yield t/ha | Protein % | H.I. % |
| **1.** | - | - | - | 0 | 7.10 - | 13.0 c | 45.3 - |
| **2.** | 50 | 50 | - | 100 | 7.17 - | 13.9 b | 41.4 - |
| **3.** | 75 | 75 | - | 150 | 6.93 - | 14.5 ab | 43.6 - |
| **4.** | 100 | 100 | - | 200 | 6.97 - | 14.4 ab | 44.2 - |
| **5.** | 125 | 125 | - | 250 | 6.96 - | 14.8 a | 43.3 - |
| **6.** | 150 | 150 | - | 300 | 7.05 - | 14.9 a | 42.5 - |
| **7.** | 100 | 100 | 100 | 300 | 7.43 - | 14.5 ab | 43.7 - |
| **8.** | 125 | 125 | 100 | 350 | 7.11 - | 15.0 a | 39.7 - |
| | **Mean** | | | | **7.09** | **14.37** | **43.0** |
| | **LSD** | | | | 0.33 | 0.7 | ns |
| | **P val** | | | | 0.087 | <0.001 | 0.396 |

The starting soil nitrogen for the research site was high following fallow in 2019 and a failed faba bean crop in 2018. This resulted in a high level of soil mineral N being available to the trial on the date of sowing seven days later.

Soil Available Mineral N kg N/ha – recorded on 12th May

| | |
|---|---|
| 0 – 30cm | 110 |
| 30 - 60cm | 71 |
| 60 – 90cm | 51 |
| **Total 0-90cm** | **232** |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 2.** Influence of applied nitrogen rate at GS30, GS32 & GS39 on dry matter (DM) kg/ha and N offtake (kg N/ha) in grain at harvest.

| Nitrogen Treatment Rate & Timing | | Total Nitrogen | Dry matter & N offtake | |
|---|---|---|---|---|
| | | | Dry Matter | N removed |
| | | N/ha | Kg/ha | Kg N/ha |
| **1.** | 0 kg N/ha | 0 | 15.96 - | 261 - |
| **2.** | 50 kg N/ha @ GS30 & 50 kg N/ha @ GS32 | 100 | 17.37 - | 246 - |
| **3.** | 75 kg N/ha @ GS30 & 75 kg N/ha @ GS32 | 150 | 15.93 - | 278 - |
| **4.** | 100 kg N/ha @ GS30 & 100 kg N/ha @ GS32 | 200 | 15.76 - | 269 - |
| **5.** | 125 kg N/ha @ GS30 & 125 kg N/ha @ GS32 | 250 | 16.12 - | 347 - |
| **6.** | 150 kg N/ha @ GS30 & 150 kg N/ha @ GS32 | 300 | 16.66 - | 360 - |
| **7.** | 100 kg N/ha @ GS30, 100 kg N/ha @ GS32 & 100 kg N/ha @ GS39 | 300 | 17.08 - | 384 - |
| **8.** | 125 kg N/ha @ GS30, 125 kg N/ha @ GS32 & 100 kg N/ha @ GS39 | 350 | 17.97 - | 307 - |
| | **Mean** | | **16.61** | |
| | **LSD** | | ns | |
| | **P val** | | 0.259 | |

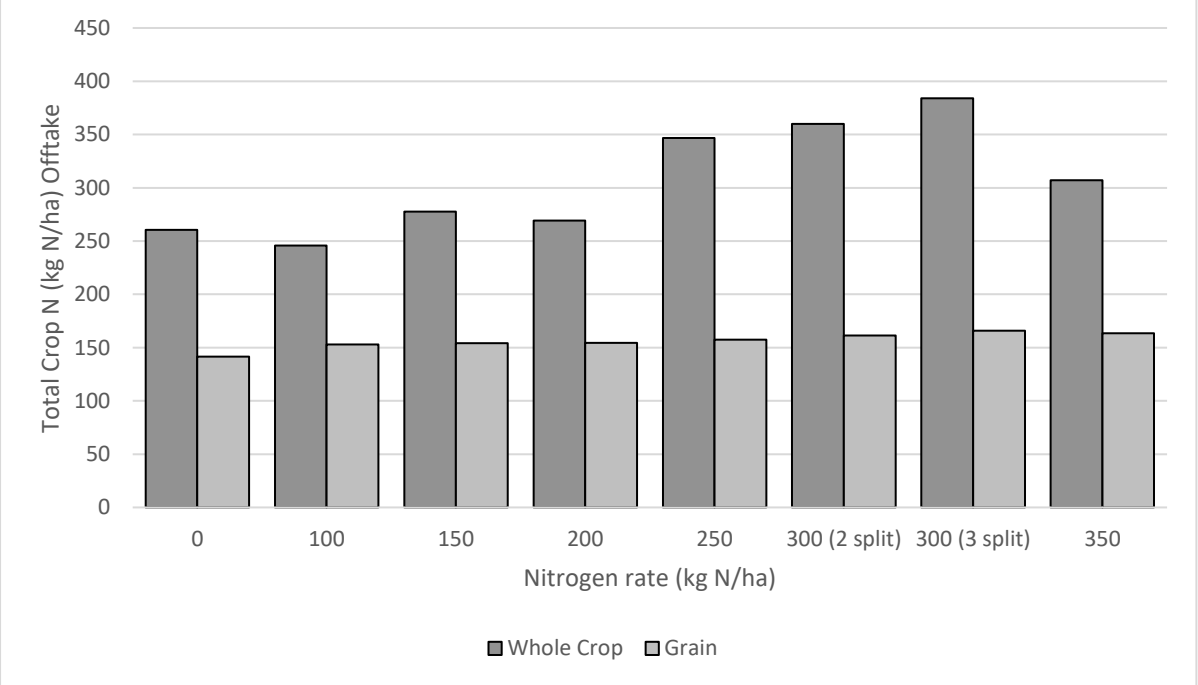


**Figure 1.** Nitrogen removed in the whole crop and grain when varying nitrogen rate.



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**Water Use Efficiency (WUE)**

**Table 3.** Maximum biomass (dry matter) at harvest, Grain yield t/ha, Harvest index (%), Water use efficiency (based on grain yield kg/ha divided by GSR mm, Irrigation mm & 30% stored Jan-March), Transpiration (mm), Estimated soil evaporation/other soil losses (mm) & Transpiration efficiency T.E. (seed) kg/mm (mean of both openers) - cv Hyola 50, Coreen, NSW.

| N Rate | Dry Matter | Yield | H.I. | WUE[1] | Trans[2] | Evap[3] | T.E[4] |
|---|---|---|---|---|---|---|---|
| (kg N/ha) | Kg/ha | Kg/ha | % | Kg/mm | mm | Mm | mm |
| 0 | 15960 | 6213 | 38.9 | 14.9 | 290 | 127 | 21.4 |
| 150 | 15930 | 6064 | 38.1 | 14.5 | 290 | 127 | 20.9 |
| 250 | 16120 | 6090 | 37.8 | 14.6 | 293 | 127 | 20.8 |
| 350 | 17970 | 6221 | 34.6 | 14.9 | 327 | 124 | 19.0 |

[1] Based on 244mm of GSR (Apr – Oct) plus 125mm irrigation and 30% of January – March rainfall as stored (48.3 mm) with no soil evaporation term included. Total 417.3mm of water available.

[2] Transpiration through the plant based on a maximum 55 kg biomass/ha.mm transpired.

[3] Difference between transpiration through the plant and GSR (mm).

[4] kg/ha grain produced per mm of water transpired through the plant.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Trial 4 Nitrogen Use Efficiency Trial – Nitrogen Timing Trial

**Project Objective:** To assess the impact of nitrogen (N) timing on durum wheat under overhead irrigation

**Location:** Finley IRC
**FAR Code:** FAR D20-04-1
**Sown:** 19 May
**Cultivar:** DBA Vittaroi
**Harvested:** 29th November 2020
**Rotation position:** Fallow (2019), Faba beans (2018), Wheat (2017)
**Soil Management:** Cultivation with speed disc in Autumn
**Irrigation:** Overhead lateral Irrigation 5 x 25mm in spring. Total applied 125mm (1.25 ML/ha)
**GSR:** April-October 244mm. Total water available 369mm

**Key Messages:**

- *In this fertile scenario (232kg N/ha available 0-90cm) there was a significant interaction (p=0.03) between applied nitrogen timing and rate which suggested that increasing nitrogen had no negative yield effects when applied later in stem elongation compared to earlier N timings of the same amounts.*
- *However, the only benefit of applied nitrogen in the trial was significantly lifting grain protein from below 13% (12.36% mean) in zero N plots to 13.63% in those plots where 100kg N/ha was applied.*
- *The input of N fertiliser at $1.20kg N/ha was not economic in this trial, despite the premium differential due to protein (based on $19/t differential).*
- *Whilst applied nitrogen at 300kg N/ha significantly increased protein above 14% compared to lower levels of applied N this effect was uneconomic.*
- *There was an indication that N content of the canopy varied with N rate and timing at harvest with content varying from 250 -365 kg N/ha.*
- *N removal*
- *Applying higher rates of nitrogen had a significant impact on crop reflectance assessed as normalised differential vegetation index (NDVI) at early stem elongation, booting and flowering*

With high levels of available mineral N at sowing (232kg N/ha 0 -90cm) there was no economic yield or protein response to applied N fertiliser (Urea 46%N) (Table 1).



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 1.** Influence of N rate and timing strategies on grain yield (t/ha) based on split application rates (0 – 300kg N/ha).

| | Nitrogen Application Rate | | | |
|---|---|---|---|---|
| | 0kg/ha N | 100kg/ha N | 200kg/ha N | 300kg/ha N |
| **Nitrogen Timing** | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** |
| **PSPE & GS30** | 7.25 a-e | 7.43 abc | 7.06 cde | 7.16 b-e |
| **GS30 & GS32** | 7.54 a | 6.89 e | 6.97 de | 7.09 cde |
| **GS32 & GS37** | 7.33 a-d | 7.48 ab | 7.50 ab | 7.36 abc |
| **Mean** | **7.37 -** | **7.27 -** | **7.18 -** | **7.20 -** |
| | | | | |
| **LSD N Application Timing p=0.05** | ns | **P val** | 0.187 | |
| **LSD N Application Rate p=0.05** | ns | **P val** | 0.292 | |
| **LSD N Timing. x N Rate. P=0.05** | 0.38 | **P val** | 0.033 | |

*PSPE – Post sow pre-emergence application - broadcast*
*In addition to N rates specified a standard MAP application meant that all treatments received 12 kg N/ha at sowing.*

**Table 2.** Influence of N rate and timing strategies on grain protein (%) based on split application rates (0 – 300kg N/ha).

| | Nitrogen Application Rate | | | | |
|---|---|---|---|---|---|
| | 0kg/ha N | 100kg/ha N | 200kg/ha N | 300kg/ha N | |
| **Nitrogen Timing** | **Protein %** | **Protein %** | **Protein %** | **Protein %** | **Mean** |
| **PSPE & GS30** | 12.7 de | 13.5 c | 13.4 cd | 14.1 abc | 13.4 - |
| **GS30 & GS32** | 12.7 e | 13.5 c | 13.9 bc | 14.5 ab | 13.6 - |
| **GS32 & GS37** | 11.7 f | 13.8 bc | 14.3 ab | 14.8 a | 13.6 - |
| **Mean** | **12.4 c** | **13.6 b** | **13.8 b** | **14.4 a** | |
| | | | | | |
| **LSD N Application Timing p=0.05** | ns | **P val** | 0.703 | | |
| **LSD N Application Rate p=0.05** | 0.46 | **P val** | <0.001 | | |
| **LSD N Timing. x N Rate. P=0.05** | 0.80 | **P val** | 0.030 | | |

**Table 3** Influence of N rate and timing strategies on N removal kg N/ha at harvest.

| | Nitrogen removed at harvest (kg N/ha) | | | |
|---|---|---|---|---|
| | 0kg/ha N | 100kg/ha N | 200kg/ha N | 300kg/ha N |
| **Nitrogen Timing** | | | | |
| **PSPE & GS30** | 270 cde | 324 abc | 365 a | 336 ab |
| **GS30 & GS32** | 298 b-e | 251 e | 260 e | 296 b-e |
| **GS32 & GS37** | 266 de | 320 a-d | 287 b-e | 319 a-d |
| **Mean** | **278 -** | **298 -** | **304 -** | **317 -** |
| | | | | |
| **LSD N Application Timing p = 0.05** | 39 | **P val** | 0.067 | |
| **LSD N Application Rate p=0.05** | ns | **P val** | 0.111 | |
| **LSD N Timing. x N Rate. P=0.05** | 55 | **P val** | 0.028 | |



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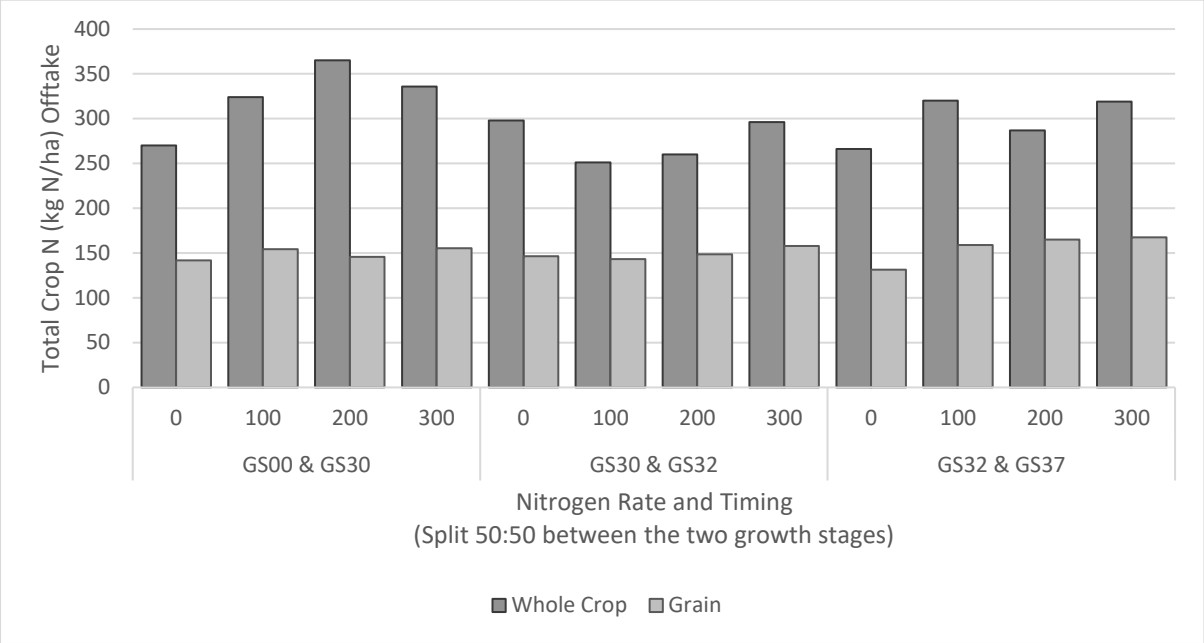


**Figure 1.** Influence of N rate and timing on nitrogen offtake in the crop canopy at harvest kg N/ha (straw and grain) – cv DBA Vittaroi.

Small but significant differences were observed in crop reflectance (Table 4) which indicated greener canopies where higher N rates were applied. However, overall the differences though significant are extremely small (Table 4).

**Table 4.** Influence of N rate (kg N/ha) on crop reflectance assessed as normalised differential vegetation index (NDVI) assessed 0 -1 scale. *Higher figures are indicative of greener canopies.*

| | NDVI | | |
|---|---|---|---|
| | **GS32 (26 Aug)** | **GS43 (14 Sep)** | **GS61 (29 Sep)** |
| **Nitrogen Rate** | | | |
| **0 kg N/ha** | 0.790 c | 0.814 b | 0.813 b |
| **100 kg N/ha** | 0.793 bc | 0.814 b | 0.815 b |
| **200 kg N/ha** | 0.802 ab | 0.822 a | 0.824 a |
| **300 kg N/ha** | 0.805 a | 0.821 ab | 0.823 a |
| **Mean** | **0.798** | **0.815** | **0.818** |
| **LSD** | 0.010 | 0.007 | 0.007 |
| **P val** | 0.017 | 0.045 | 0.003 |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Trial 5 Germplasm Disease Management Interaction

**Project objective:** To assess the relative importance of fungicide input for DBA Aurora and DBA Vittaroi under overhead irrigation

**Location:** Finley IRC
**Sown:** 19 May
**Harvested:** 29th November 2020
**FAR Code:** FAR D20-07-1
**Cultivar:** DBA Aurora and DBA Vittaroi
**Rotation position:** Fallow (2019), Faba beans (2018), Wheat (2017)
**Soil Management:** Cultivation with speed disc in Autumn
**Irrigation:** Overhead lateral Irrigation 5 x 25mm in spring. Total applied 125mm (1.25 ML/ha)
**GSR:** April-October 244mm. Total water available 369mm

**Key Messages:**

- *DBA Vittaroi developed higher levels of stripe rust infection than DBA Aurora (20% v less than1% on flag leaf at late grain fill)*
- *Fungicide strategy had no significant effect on grain protein (range 13.4-14.8%) which averaged 14.0% (not shown)*
- *DBA Aurora at 13.5% had significantly less grain protein than DBA Vittaroi at 14.5% (not shown)*

**Table 1.** Fungicide treatment list.

| | | Treatment mL/ha | | | |
|---|---|---|---|---|---|
| | **Treatment** | **At sowing 19 May** | **GS31 3 Aug** | **GS39 1 Sep** | **GS61 2 Oct** |
| **1.** | **Untreated** | | | | |
| **2.** | **1 spray (GS31)** | | Amistar Xtra 400 | | |
| **3.** | **1 spray (GS39)** | | | Radial 400 | |
| **4.** | **2 spray** | | Prosaro 300 | Radial 400 | |
| **5.** | **s.t. + 2 spray** | Systiva | | Radial 400 | Prosaro 300 |
| **6.** | **3 spray** | | Aviator 416 | Radial 400 | Prosaro 300 |

*S.t. Seed treatment: Systiva applied at 150mL/100kg seed*

**Table 2.** Grain yield under different fungicide strategies.

| | | Grain Yield | | |
|---|---|---|---|---|
| | | **DBA Aurora** | **DBA Vittaroi** | **Mean** |
| | **Treatment** | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** |
| **1.** | **Untreated** | 6.44 - | 5.77 - | **6.10 bc** |
| **2.** | **1 spray (GS31)** | 6.24 - | 5.55 - | **5.90 c** |
| **3.** | **1 spray (GS39)** | 6.57 - | 6.06 - | **6.32 b** |
| **4.** | **2 spray** | 6.77 - | 6.57 - | **6.67 a** |
| **5.** | **s.t. + 2 spray** | 6.58 - | 6.22 - | **6.40 ab** |
| **6.** | **3 spray** | 6.86 - | 6.48 - | **6.67 a** |
| | | | | |
| | **Mean** | **6.58 a** | **6.11 b** | |
| | | | | |
| **LSD Fungicide p = 0.05** | | 0.3 | **P val** | <0.001 |
| **LSD Cultivar p=0.05** | | 0.17 | **P val** | <0.001 |
| **LSD Fungicide x Cultivar P=0.05** | | ns | **P val** | 0.4926 |

Released:24 February 2021

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**Table 3.** Influence of variety and fungicide strategy on % Stripe rust leaf area infection (%LAI) on flag leaf, F-1 and F-2 at awn emergence (GS49) & soft dough (GS85) – Assessed 24 Sep and 6 Nov respectively.

| | | GS49 %LAI | | | GS 85 %LAI | |
|---|---|---|---|---|---|---|
| | | Flag Leaf | Flag-1 | Flag-2 | Flag Leaf | Flag-1 |
| | **DBA Aurora** | | | | | |
| **1.** | Untreated | 0.0 - | 0.2 c | 0.8 - | 0.6 b | 1.3 b |
| **2.** | 1 spray (GS31) | 0.0 - | 0.1 c | 0.6 - | 0.7 b | 0.5 b |
| **3.** | 1 spray (GS39) | 0.0 - | 0.4 c | 0.7 - | 0.2 b | 0.0 b |
| **4.** | 2 spray (GS31 & 39) | 0.0 - | 0.3 c | 0.4 - | 0.0 b | 0.0 b |
| **5.** | S.t. + 2 spray (GS39 & | 0.0 - | 0.3 c | 0.9 - | 0.0 b | 0.0 b |
| **6.** | 3 spray (GS31, 39 & 61) | 0.0 - | 0.3 c | 0.6 - | 0.0 b | 0.0 b |
| | **DBA Vittaroi** | | | | | |
| **1.** | Untreated | 0.4 - | 5.1 a | 3.7 - | 19 a | 20 a |
| **2.** | 1 spray (GS31) | 0.2 - | 2.6 b | 2.4 - | 15 a | 17 a |
| **3.** | 1 spray (GS39) | 0.6 - | 4.7 a | 5.8 - | 0.6 b | 1.6 b |
| **4.** | 2 spray (GS31 & 39) | 0.1 - | 1.9 b | 2.2 - | 0.7 b | 0.5 b |
| **5.** | S.t. + 2 spray (GS39 & | 0.6 - | 4.7 a | 4.7 - | 1.0 b | 2.0 b |
| **6.** | 3 spray (GS31, 39 & 61) | 0.2 - | 1.9 b | 2.2 - | 0.6 b | 0.4 b |

| | | | | | |
|---|---|---|---|---|---|
| **LSD Cultivar p=0.05** | 0.1 | 0.5 | 0.8 | 2.1 | 2.7 |
| **P val** | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **LSD Fungicide x Cultivar** | ns | 1.3 | 2.0 | 5.0 | 6.5 |
| **P val** | 0.143 | 0.002 | 0.096 | <0.001 | <0.001 |

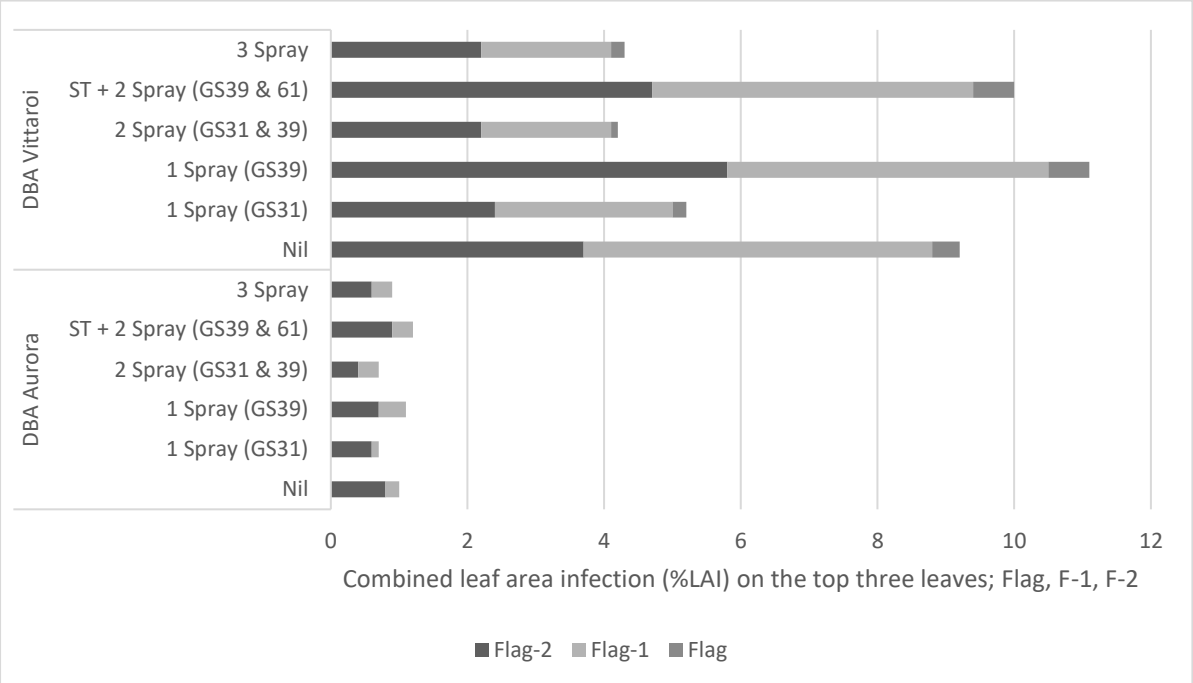


**Figure 1.** Influence of fungicide strategy on stripe rust infection (% leaf area infected) on flag, F-1 and F-2 at (GS49) in durum wheat grown under overhead irrigation. Note GS61 still to applied.

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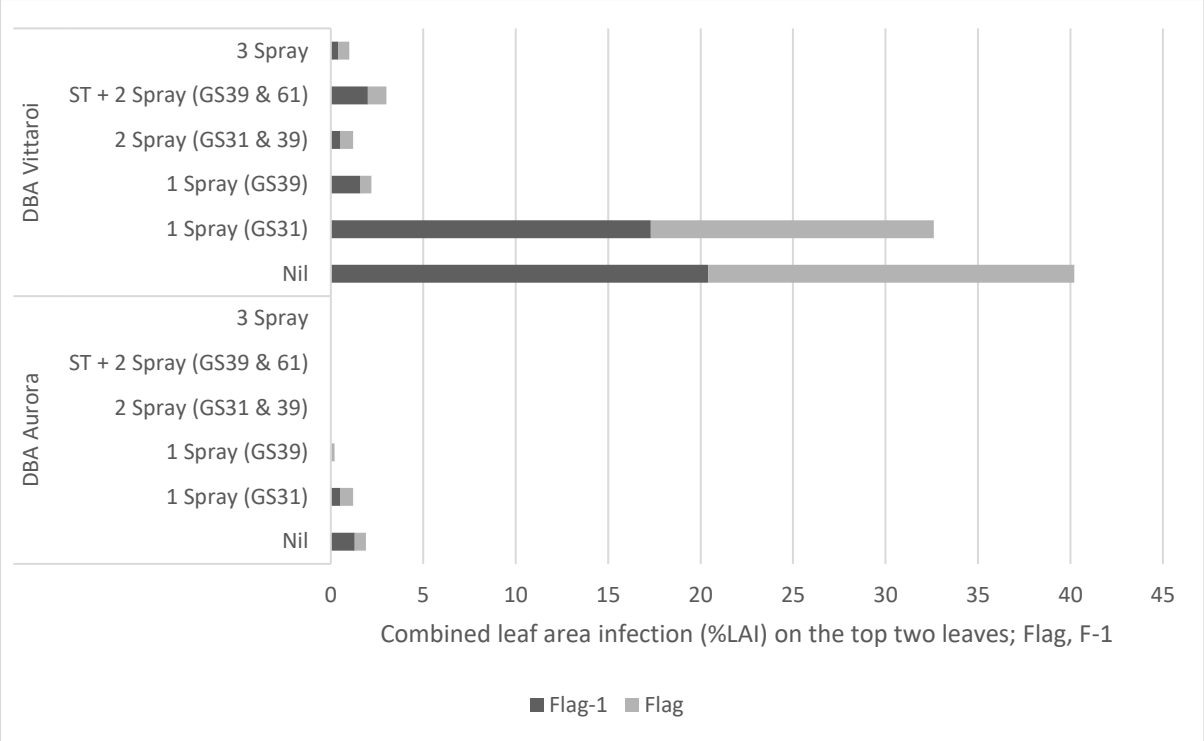


**Figure 2.** Influence of fungicide strategy on stripe rust infection (% leaf area infected) on flag, F-1 and F-2 at (GS85) in durum wheat grown under overhead irrigation.



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## Trial 6 Disease Management for Irrigated Crops – Products, Rates and Timings

**Project objective:** To assess the impact of fungicide management strategies with and without upfront at seeding fungicide options

**Location:** Finley IRC
**FAR Code:** FAR D20-08-1
**Sown:** 19 May
**Cultivar:** DBA Vittaroi
**Harvested:** 29th November 2020
**Rotation position:** Fallow (2019), Faba beans (2018), Wheat (2017)
**Soil Management:** Cultivation with speed disc in Autumn
**Irrigation:** Overhead lateral Irrigation 5 x 25mm in spring. Total applied 125mm (1.25 ML/ha)
**GSR:** April-October 244mm. Total water available 369mm

**Key Messages:**

- *Fungicide strategies generated yield increases of between 0.29 – 0.77t/ha from the control of stripe rust (valued at $117 – 312/ha at $405/t).*
- *All fungicide strategies significantly increased yield.*
- *The stripe rust control data and yield results indicated that 2 spray foliar strategies or flutriafol plus a follow up foliar spray could be used to secure disease control and yield responses.*
- *Small benefits to a third foliar spray were not significantly better than the equivalent two spray programme.*
- *There was no significant difference in grain yield between treatments using Opus and Radial at GS31*
- *Systiva at sowing was just as effective in maintaining grain yield as Opus at GS31 but gave less effective stripe rust control than flutriafol and Jockey.*
- *Jockey and Flutriafol at sowing were not as effective in maintaining grain yield as Opus at GS31.*



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**Table 1.** Influence of fungicide treatment on grain yield.

| | | Treatment mL/ha | | | | Yield |
|---|---|---|---|---|---|---|
| | Treatment Name | At sowing | GS31 | GS39 | GS61 | t/ha |
| 1. | 0 Units | Untreated | | | | 6.05 c |
| 2. | Systiva + 1 Spray Unit | Systiva Seed Trt | | Prosaro 300 | | 6.96 b |
| 3. | Jockey + 1 Spray Unit | Jockey Seed Trt | | Prosaro 300 | | 6.87 b |
| 4. | Flutriafol + 1 Spray Unit | Flutriafol in furrow | | Prosaro 300 | | 6.82 b |
| 5. | 2 Spray (O + P) | | Opus 500 | Prosaro 300 | | 7.11 ab |
| 6. | 2 Spray (O + A) | | Opus 500 | Aviator 416 | | 6.87 b |
| 7. | 2 Spray (R + A) | | Radial 840 | Aviator 416 | | 6.87 b |
| 8. | 3 Spray (O+P+O) | | Opus 500 | Prosaro 300 | Opus 250 | 7.30 a |
| 9. | 3 Spray (O+A+O) | | Opus 500 | Aviator 416 | Opus 250 | 6.99 b |
| 10. | 3 Spray (R+A+O) | | Radial 840 | Aviator 416 | Opus 250 | 6.97 b |
| | Mean | | | | | 6.93 |
| | LSD | | | | | 0.365 |
| | P val | | | | | 0.0321 |

**Table 2.** Influence of fungicide treatment on grain quality - protein content (%), test weight (kg/hl) and screenings (%).

| Treatment | | Grain quality | | |
|---|---|---|---|---|
| | | Protein % | Test Weight Kg /hL | Screenings % |
| 1. | Untreated | 14.3 - | 76.3 - | 1.2 - |
| 2. | S.t. fb 1 Spray | 14.3 - | 77.2 - | 1.1 - |
| 3. | Jockey fb 1 Spray | 14.1 - | 77.1 - | 1.0 - |
| 4. | Fl fb 1 Spray | 14.5 - | 77.3 - | 1.1 - |
| 5. | 2 Spray (O + P) | 14.1 - | 77.4 - | 1.1 - |
| 6. | 2 Spray (O + A) | 14.4 - | 76.6 - | 1.4 - |
| 7. | 2 Spray (R + A) | 14.4 - | 77.3 - | 1.2 - |
| 8. | 3 Spray (O+P+O) | 14.2 - | 77.8 - | 1.0 - |
| 9. | 3 Spray (O+A+O) | 14.5 - | 77.6 - | 1.2 - |
| 10. | 3 Spray (R+A+O) | 14.5 - | 77.0 - | 1.2 - |
| | **Mean** | **14.3** | **77.2** | **1.1** |
| | **LSD** | ns | ns | Ns'[ |
| | **P val** | 0.503 | 0.366 | 0.313 |

*Fb – followed by*

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**Table 3.** Influence of fungicide treatment on stripe rust infection assessed at GS49 (23-Sep) and GS65 (8-Oct).

| Treatment | | Stripe rust infection (% LAI) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Infection at GS49 | | | Infection at GS65 | | |
| | Treatment Name | Flag | Flag-1 | Flag-2 | Flag | Flag-1 | Flag-2 |
| **1.** | Untreated | 0.2 - | 1.5 ab | 3.2 a | 11.5 a | 15.1 a | 29.6 a |
| **2.** | S.t. fb 1 Spray | 0.2 - | 1.2 abc | 2.0 a b | 2.7 b | 3.0 b | 5.6 b |
| **3.** | Jockey fb 1 Spray | 0.1 - | 0.7 bcd | 1.4 bc | 2.2 bcd | 1.9 bc | 2.2 bc |
| **4.** | Fl fb 1 Spray | 0.0 - | 0.3 d | 0.3 c | 0.7 d | 0.9 c | 1.5 c |
| **5.** | 2 Spray (O + P) | 0.2 - | 0.8 a-d | 1.8 b | 1.8 bcd | 1.8 bc | 3.2 bc |
| **6.** | 2 Spray (O + A) | 0.1 - | 0.8 a-d | 1.8 b | 1.0 cd | 2.9 b | 2.5 bc |
| **7.** | 2 Spray (R + A) | 0.0 - | 1.6 a | 1.4 bc | 1.5 bcd | 1.9 bc | 3.6 bc |
| **8.** | 3 Spray (O+P+O) | 0.1 - | 1.1 abc | 1.5 bc | 1.3 bcd | 1.7 bc | 1.8 c |
| **9.** | 3 Spray (O+A+O) | 0.2 - | 1.3 ab | 1.0 bc | 2.4 bc | 2.8 b | 3.8 bc |
| **10.** | 3 Spray (R+A+O) | 0.0 - | 0.4 cd | 1.0 bc | 2.3 bc | 1.7 bc | 2.9 bc |
| | **Mean** | **0.1** | **1.0** | **1.5** | **2.7** | **3.4** | **5.7** |
| | **LSD** | 0.3 | 0.8 | 1.3 | 1.5 | 1.8 | 3.4 |
| | **P val** | 0.685 | 0.029 | 0.017 | <0.001 | <0.001 | <0.001 |

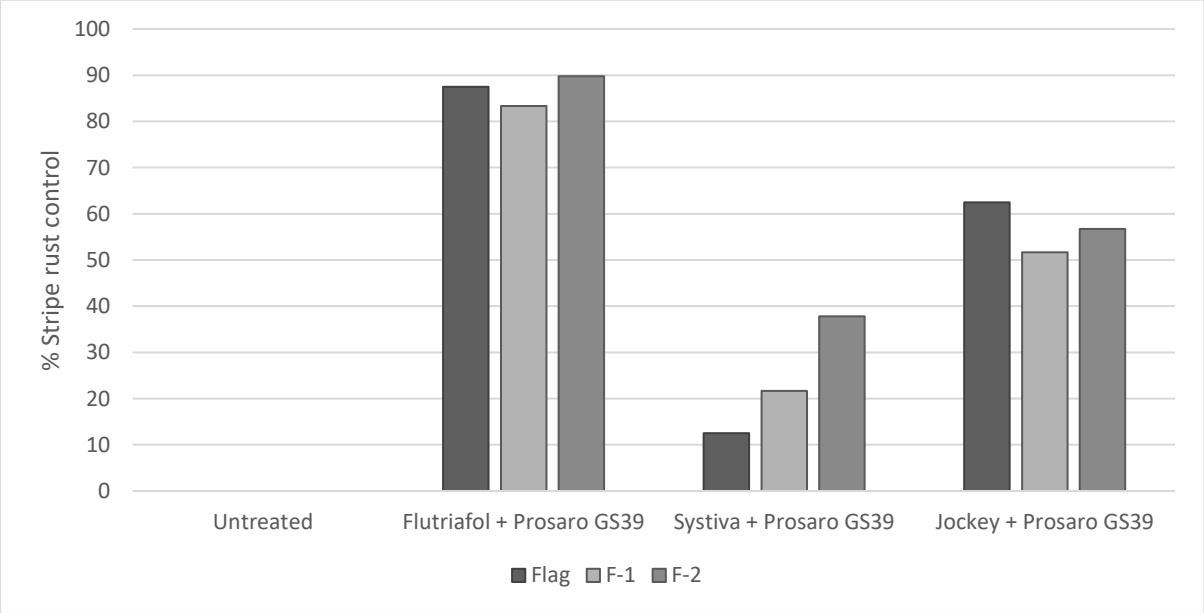


**Figure 1.** Stripe rust control (% with untreated set as 0% control) of at sowing treatments. Assessed 23/9 (GS49).

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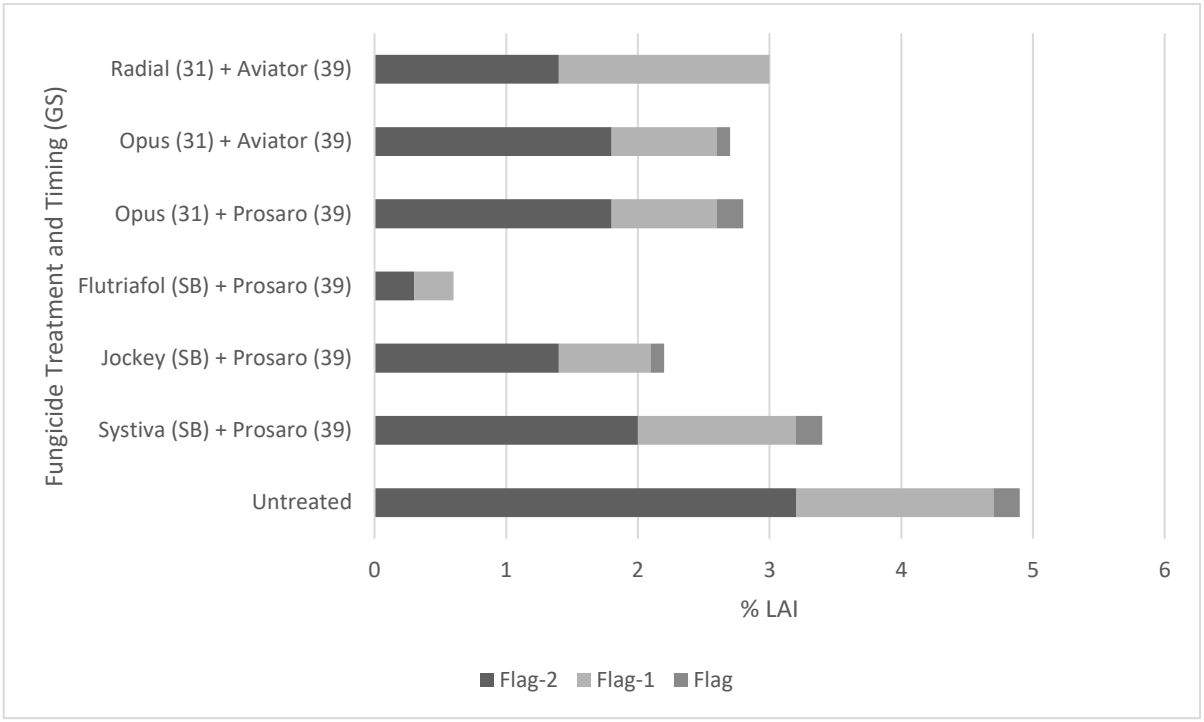


**Figure 2**. Stripe rust infection (% leaf area infected) at GS49 (23-Sep).
*SB – Seedbed at sowing.*

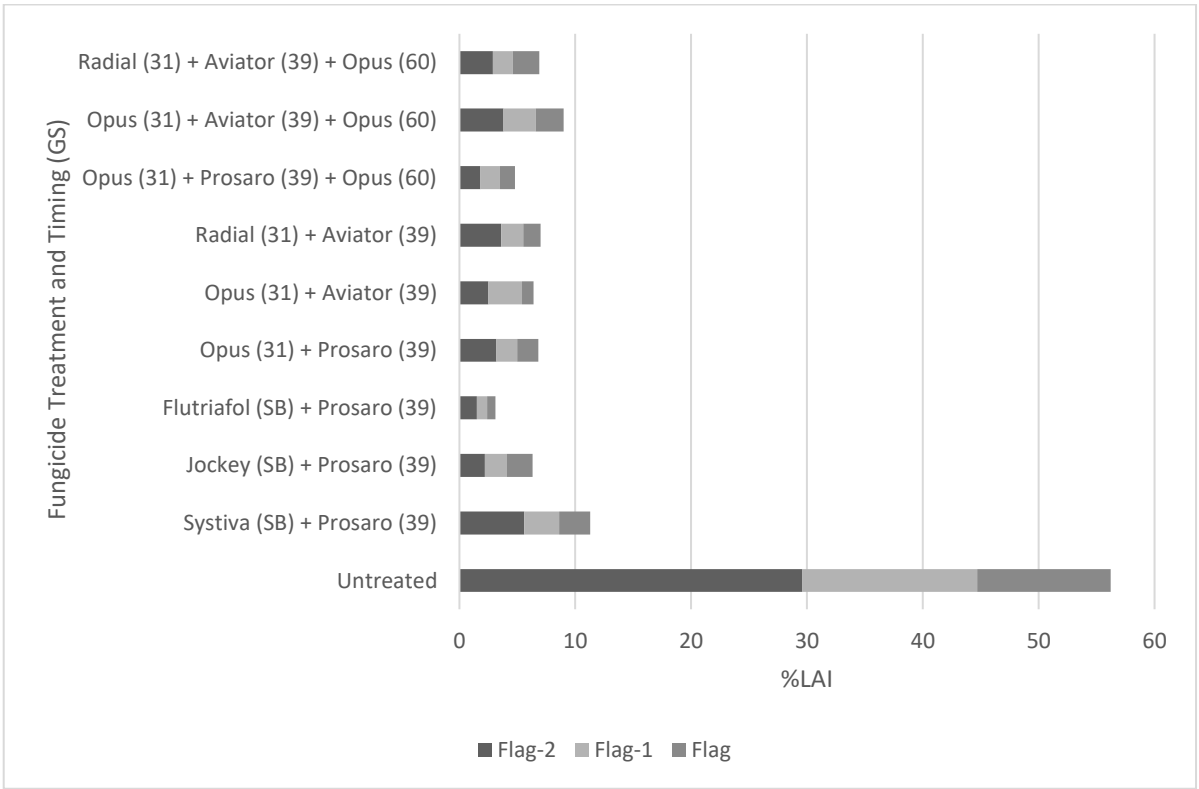


**Figure 3.** Stripe rust infection (% leaf area infected) at GS65 (8-Oct).



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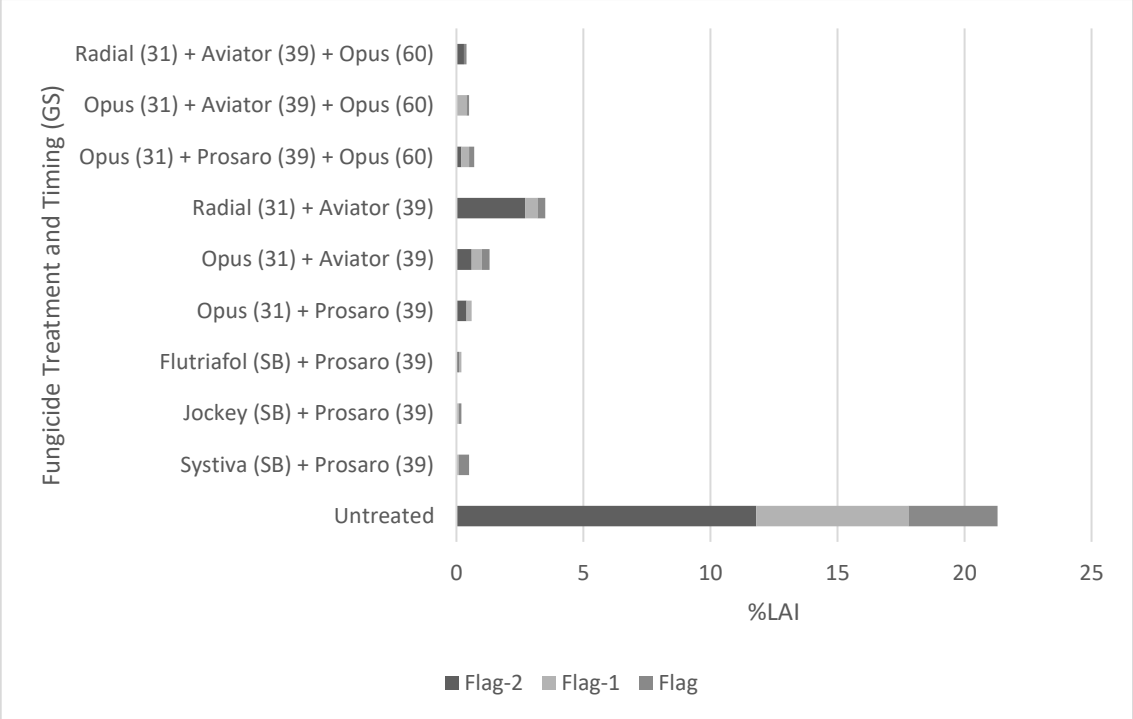


**Figure 4.** Stripe rust infection (% leaf area infected) at GS83 (29-Oct).



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## Trial 7 Influence of Plant Growth Regulation on Durum Yield and Profitability under Irrigation

**Location:** Finley IRC
**FAR Code:** FAR D20-09-1
**Sown:** 19 May
**Cultivar:** DBA Aurora
**Harvested:** 29th November 2020
**Rotation position:** Fallow (2019), Faba beans (2018), Wheat (2017)
**Soil Management:** Cultivation with speed disc in Autumn
**Irrigation:** Overhead lateral Irrigation 5 x 25mm in spring. Total applied 125mm (1.25 ML/ha)
**GSR:** April-October 244mm. Total water available 369mm

**Key Messages:**

- *A number of PGR strategies based on Moddus Evo (trinexapac ethyl), Errex (chlormequat) and a coded PGR were noted to significantly reduce lodging in irrigated DBA Aurora.*
- *Reduction in lodging whilst significant did not significantly increase yield relative to the untreated control, a factor associated with later occurrence of the lodging in grain fill (GS87 late dough).*
- *Grazing twice at tillering and at pseudo stem erect (GS22 &30) prevented lodging and was more effective than a number of PGR programmes, however it significantly reduced yield relative to the control.*
- *Sequences of PGR treatment with the first application at GS30 gave significantly better lodging control than the untreated, single applications of PGR were less effective.*
- *Small significant reductions in grain screenings were observed as a result of some treatments*

**Table 1.** Influence of PGR strategy on Grain yield (t/ha) and Screening (%).

| PGR Treatment | | | Grain yield and quality | |
|---|---|---|---|---|
| | | | Yield | Screenings |
| **No.** | **Product and Rate** | **Timing** | **t/ha** | **%** |
| **1.** | Untreated | | 7.50 ab | 3.6 a |
| **2.** | Moddus Evo 200mL/ha + Errex 1.3L/ha | GS31-32 | 7.50 ab | 2.8 c |
| **3.** | Moddus Evo 100mL/ha + Errex 0.65L/ha<br>Moddus Evo 100mL/ha + Errex 0.65L/ha | GS30<br>GS32 | 7.65 ab | 2.5 cd |
| **4.** | Errex 1.3L/ha<br>Moddus Evo 200mL/ha | GS30<br>GS32 | 7.69 ab | 2.6 cd |
| **5.** | Errex 0.65L/ha<br>Moddus Evo 200mL/ha + Errex 0.65L/ha | GS30<br>GS32 | 7.71 ab | 2.8 c |
| **6.** | Moddus Evo 200mL/ha + Errex 1.3L/ha<br>FAR PGR 20/01 0.75 L/ha | GS31-32<br>GS39 | 7.80 a | 2.7 c |
| **7.** | Moddus Evo 100mL/ha + Errex 0.65L/ha<br>Moddus Evo 100mL/ha + Errex 0.65L/ha<br>FAR PGR 20/01 0.75 L/ha | GS30<br>GS32<br>GS37 | 7.77 a | 2.7 c |
| **8.** | FAR PGR 20/01 0.75 L/ha | GS39 | 7.61 ab | 3.0 bc |
| **9.** | Grazing (twice GS22 & GS30) | GS22 & GS30 | 6.63 c | 2.1 d |
| **10.** | FAR PGR 20/01 0.75 L/ha + Errex 1.3 L/ha | GS32 | 7.28 b | 3.4 ab |
| | **Mean** | | **7.51** | **2.81** |
| | **LSD** | | 0.435 | 0.52 |
| | **P val** | | <0.001 | <0.001 |



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**Table 2.** Dry matter removed (kg/ha) and timing of mechanical defoliation.

| | Grazing Defoliation | | |
|---|---|---|---|
| **Growth Stage** | GS23 | GS31 | **Total** |
| **Date** | 14 July | 31 July | |
| **Dry Matter removed (kg/ha)** | 233 | 345 | 578 |

**Table 3.** Influence of PGR treatment and grazing on lodging index score (% plot area lodged x severity 0-5 scale (0-500)).

| | | | Lodging | |
|---|---|---|---|---|
| | | | **17 Nov (GS87)** | **29 Nov (Harvest)** |
| **No.** | **Product and Rate** | **Timing** | **Score (0-500)** | **Score (0-500)** |
| **1.** | Untreated | | 109 - | 223 a |
| **2.** | Moddus Evo 200mL/ha + Errex 1.3L/ha | GS31-32 | 90 - | 134 ab |
| **3.** | Moddus Evo 100mL/ha + Errex 0.65L/ha | GS30 | | |
| | Moddus Evo 100mL/ha + Errex 0.65L/ha | GS32 | 47 - | 71 bc |
| **4.** | Errex 1.3L/ha | GS30 | | |
| | Moddus Evo 200mL/ha | GS32 | 24 - | 39 bc |
| **5.** | Errex 0.65L/ha | GS30 | | |
| | Moddus Evo 200mL/ha + Errex 0.65L/ha | GS32 | 11 - | 56 bc |
| **6.** | Moddus Evo 200mL/ha + Errex 1.3L/ha | GS31-32 | | |
| | FAR PGR 20/01 0.75 L/ha | GS39 | 29 - | 73 bc |
| **7.** | Moddus Evo 100mL/ha + Errex 0.65L/ha | GS30 | | |
| | Moddus Evo 100mL/ha + Errex 0.65L/ha | GS32 | | |
| | FAR PGR 20/01 0.75 L/ha | GS37 | 14 - | 56 bc |
| **8.** | FAR PGR 20/01 0.75 L/ha | GS39 | 40 - | 85 bc |
| **9.** | Grazing (twice GS22 & GS30) | GS22 & GS30 | 0 - | 0 c |
| **10.** | FAR PGR 20/01 0.75 L/ha + Errex 1.3 L/ha | GS32 | 79 - | 145 ab |
| | **Mean** | | **44.3** | **88.1** |
| | **LSD** | | 77 | 110 |
| | **P val** | | 0.097 | 0.019 |

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# Kerang VIC

*Irrigated trials conducted at the Kerang irrigated research centre 2020 were managed by the Irrigated Cropping Council*

## Trial 1 Optimum Plant Population Under Sprinkler Irrigation

**Location:** Kerang, Victoria
**FAR Code:** ICC D20-01-3
**Sown:** 29 May
**Cultivar:** DBA Aurora and DBA Vittaroi
**Harvested:** 11 December 2020
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Overhead sprinkler irrigation 8 applications totalling 208mm (2.08 ML/ha)
**GSR:** April-October 250mm. Total water available 458mm

***Key Messages:***

- *The average establishment rate for the trial averaged 6%.*
- *There were differences in biomass at GS31, with the trend to lower biomass at lower seeding rates and this was reflected in shoot numbers.*
- *Yield was not influenced by plant population in either variety.*
- *Yield was below expectations which appears to be due to inadequate irrigation although the amount of irrigation applied exceeded the evaporation in the spring period.*
- *The lowest sowing rate of 100 seeds/m$^2$ equates to a plant population of approximately 76 plants/m$^2$ or*
- *Harvest Index ranged from 0.33 to 0.39 with the exception of one treatment.*
- *Water use efficiency was 15.5 kg/mm*

**Table 1.** Establishment - Plant population (plants/m$^2$) established from four seed rates with two different cultivars grown under overhead irrigation.

| | Established Population | | |
|---|---|---|---|
| **Seed Rate** | **DBA Aurora** | **DBA Vittaroi** | **Mean** |
| | **Plants/m$^2$** | **Plants/m$^2$** | **Plants/m$^2$** |
| **100 seeds/m$^2$** | 68.0 d | 76.8 cd | **72.4 d** |
| **200 seeds/m$^2$** | 148.0 bc | 113.5 c | **130.8 c** |
| **300 seeds/m$^2$** | 176.5 b | 177.8 b | **177.1 b** |
| **400 seeds/m$^2$** | 230.5 a | 219.5 a | **225.0 a** |
| **Mean** | **155.8** | **146.9** | 151.3 |

| | | | |
|---|---|---|---|
| **LSD Seed Rate p = 0.05** | 26.21 | **P val** | <0.001 |
| **LSD Cultivar p=0.05** | 18.53 | **P val** | 0.331 |
| **LSD Seed Rate x Cultivar.** | 37.06 | **P val** | 0.336 |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 2.** Influence of plant population on canopy composition, plants/m$^2$ (GS21), tillers/m$^2$ (GS31) and heads/m$^2$ (GS87) – assessed GS21 (29 Jun), GS31 (13 Aug), GS87 (12 Dec).

| Treatment | Canopy composition | | |
|---|---|---|---|
| | Plants/m$^2$ | Tillers/m$^2$ | Heads/m$^2$ |
| **DBA Aurora** | | | |
| 100 seeds/m$^2$ | 68.0 d | 558 c | 322.9 e |
| 200 seeds/m$^2$ | 148.0 bc | 670 bc | 432.0 ab |
| 300 seeds/m$^2$ | 176.5 b | 784 ab | 460.4 ab |
| 400 seeds/m$^2$ | 230.5 a | 833 a | 485.4 a |
| **DBA Vittaroi** | | | |
| 100 seeds/m$^2$ | 76.8 cd | | 344.5 de |
| 200 seeds/m$^2$ | 113.5 c | | 359.8 cd |
| 300 seeds/m$^2$ | 177.8 b | | 404.2 bcd |
| 400 seeds/m$^2$ | 219.5 a | | 425.7 abc |
| **Mean** | **151** | | **404** |
| | | | |
| **LSD Seed Rate x Cultivar. P=0.05** | 37.06 | 121.3 | 69.98 |
| **P val Seed Rate x Cultivar. P=0.05** | 0.336 | | 0.052 |
| **P val Seed Rate P=0.05** | <0.001 | 0.003 | <0.001 |
| **P val Cultivar. P=0.05** | 0.331 | - | 0.022 |

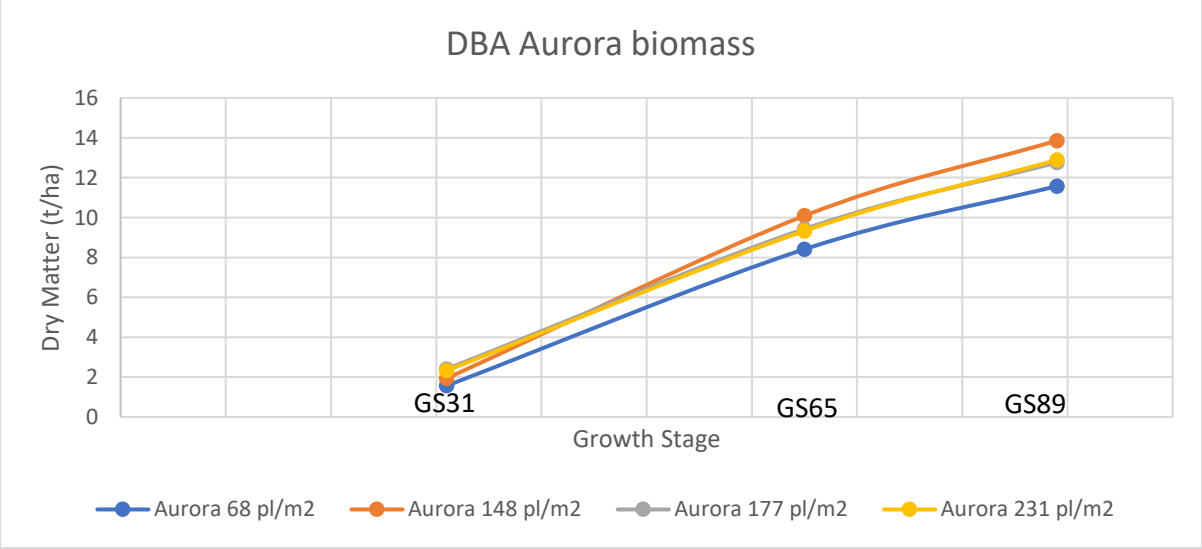


**Figure 1.** Influence of plant population on dry matter production (t/ha).

There were differences in biomass measured at GS31, reflecting shoot number and seeding rate. By flowering, there were no differences in biomass.
Maximum biomass achieved at harvest was 13.86 t DM/ha by DBA Aurora sown at 200 seeds/m2, or although this was not statistically different to any other treatment.



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**Table 3.** Influence of seed rates (plant population) on grain yield (t/ha) with two different varieties grown under overhead irrigation.

| | | *Yield* | | | *Protein* | | |
|---|---|---|---|---|---|---|---|
| **Plants/m² (actual)** | | **Aurora** | ***Vittaroi*** | ***Mean*** | ***Aurora*** | ***Vittaroi*** | ***Mean*** |
| **Aurora** | **Vittaroi** | **t/ha** | ***t/ha*** | ***t/ha*** | ***%*** | ***%*** | ***%*** |
| 68 | 77 | 4.76 - | 4.96 - | ***4.86*** - | 16.4 b | 16.2 a | **16.3** - |
| 148 | 114 | 6.10 - | 5.42 - | ***5.76*** - | 15.5 b | 16.4 a | ***15.9*** - |
| 177 | 178 | 5.92 - | 4.97 - | ***5.45*** - | 15.5 b | 16.4 a | ***15.9*** - |
| 231 | 220 | 5.72 - | 5.12 - | ***5.42*** - | 15.6 b | 16.3 a | ***15.9*** - |
| **Mean** | | **5.62** - | **5.12** - | | **15.7 b** | **16.3 a** | |

| | | |
|---|---|---|
| **LSD Cultivar p=0.05** | ns | 0.38 |
| **P val** | 0.072 | 0.006 |
| **LSD Seed Rate p=0.05** | ns | ns |
| **P val** | 0.149 | 0.490 |
| **LSD Seed Rate x Cultivar. P=0.05** | ns | 0.77 |
| **P val** | 0.474 | 0.131 |

**Table 4**. Influence of seeding rate on harvest Index.

| **Sowing Rate (seeds/m²)** | **100** | **200** | **300** | **400** |
|---|---|---|---|---|
| | **Harvest Index** | | | |
| **Aurora** | 0.36 b | 0.33 b | 0.38 b | 0.38 b |
| **Vittaroi** | 0.36 b | 0.37 b | 0.39 b | 0.45 a |

$p_{var}$ = 0.016, p $_{rate}$ = 0.010, $p_{vxr}$ = 0.213, lsd $_{vxr}$ = 0.055, cv% = 9.9

Grain yield was not significantly different from either variety or seeding rate.

Protein was not significantly different due to seeding rate in Vittaroi, but the low rate in Aurora was. This may be due to the low yield being reflected in higher protein.

Harvest Index was similar in all treatments apart from the high seeding rate in Vittaroi. Overall, the harvest index was relatively low.

The average yield for the trial was 5.4 t/ha. This represents a WUE of 15.5 kg/mm.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Trial 2 Optimum Plant Population Under Flood Irrigation

**Location:** Kerang, Victoria
**FAR Code:** ICC D20-01-4
**Sown:** 29 May
**Cultivars:** DBA Aurora and DBA Vittaroi
**Harvested:** 10 December 2020
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Flood irrigation 4 applications totalling 430mm (4.3 ML/ha)
**GSR:** April-October 250mm. Total water available 680mm

***Key Messages:***

- *The average establishment rate for the trial averaged 70% ranging from 59 – 83%, trending to higher establishment with lower seeding rates.*
- *Biomass at GS31 showed a trend to higher biomass generated by higher shoot numbers as seeding rate (plant population) increased.*
- *There was no difference in biomass at mid-flowering in DBA Aurora due to the different plant populations having similar heads numbers across all 4 seeding rates..*
- *Biomass at harvest was influenced by variety and seeding rate in DBA Vittaroi only and at a seeding rate of 300 seeds/m$^2$ or 194 plants/m$^2$. This could possibly be due to sampling variability.*
- *Seeding rate, and hence plant population had little influence on grain yield. A seeding rate of 100 seeds/m$^2$ is the equivalent of approximately 60 kg/ha seeding rate or an establishment of 70 plants/m$^2$.*
- *Protein content was influenced by variety more than seeding rate.*
- *Water use efficiency was 16.5 kg/mm*

**Table 1.** Establishment - Plant population (plants/m$^2$) established from four seed rates with two different cultivars grown under flood irrigation.

| | Established Population | | |
|---|---|---|---|
| **Seed Rate** | **DBA Aurora** | **DBA Vittaroi** | **Mean** |
| | **Plants/m$^2$** | **Plants/m$^2$** | **Plants/m$^2$** |
| **100 seeds/m$^2$** | 83.2 d | 72.0 d | **77.6 d** |
| **200 seeds/m$^2$** | 148.2 c | 166.0 c | **157.1 c** |
| **300 seeds/m$^2$** | 198.2 bc | 193.8 bc | **196.0 b** |
| **400 seeds/m$^2$** | 243.8 a | 235.0 ab | **239.4 a** |
| **Mean** | **168.4** | **166.7** | 167.5 |

| | | | |
|---|---|---|---|
| **LSD Seed Rate p = 0.05** | <0.001 | **P val** | 28.46 |
| **LSD Cultivar p=0.05** | 0.863 | **P val** | 20.12 |
| **LSD Seed Rate x Cultivar.** | 0.707 | **P val** | 40.24 |



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**Table 2.** Influence of plant population on canopy composition, plants/m$^2$ (GS21), tillers/m$^2$ (GS31) and heads/m$^2$ (GS87) – assessed GS21 (29 Jun), GS31 (13 Aug), GS87 (12 Dec).

| Treatment | Canopy composition | | |
|---|---|---|---|
| | Plants/m$^2$ | Tillers/m$^2$ | Heads/m$^2$ |
| **DBA Aurora** | | | |
| 100 seeds/m$^2$ | 83.2 d | 524 c | 370.0 bcd |
| 200 seeds/m$^2$ | 148.2 c | 681 b | 381.0 bc |
| 300 seeds/m$^2$ | 198.2 bc | 715 ab | 429.0 ab |
| 400 seeds/m$^2$ | 243.8 a | 836 a | 454.8 a |
| **DBA Vittaroi** | | | |
| 100 seeds/m$^2$ | 72.0 cd | | 295.0 e |
| 200 seeds/m$^2$ | 166.0 c | | 320.8 de |
| 300 seeds/m$^2$ | 193.8 bc | | 386.2 bc |
| 400 seeds/m$^2$ | 235.0 ab | | 331.2 cde |
| **Mean** | **167.5** | | **371** |
| | | | |
| **LSD Seed Rate x Cultivar. P=0.05** | 40.24 | 127.4 | 59.50 |
| **P val Seed Rate x Cultivar. P=0.05** | 0.707 | | 0.251 |
| **P val Seed Rate P=0.05** | <0.001 | 0.003 | 0.004 |
| **P val Cultivar. P=0.05** | 0.863 | - | <0.001 |

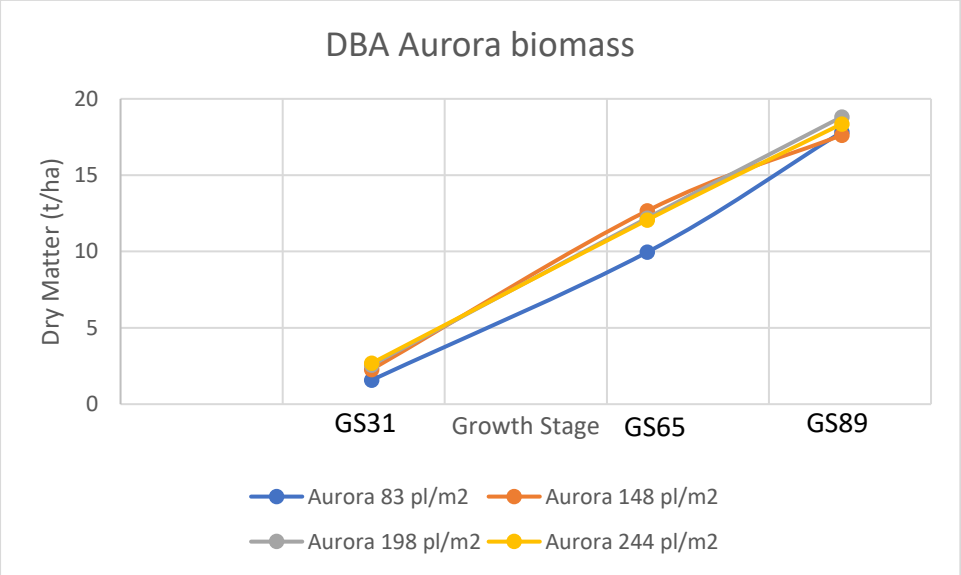


**Figure 1.** Influence of plant population on dry matter production (t/ha).

There were differences in biomass and shoots measured at GS31, with higher the plant population, the trend was for higher biomass and shoots/m$^2$.
Biomass at mid-flowering saw no difference in either head numbers or biomass in DBA Aurora.
Maximum biomass achieved at harvest was 18.54 t DM/ha in DBA Vittaroi at the 300 seeds/m2 seeding rate. Seeding rate made no difference to biomass in DBA Aurora.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 3.** Influence of seed rates (plant population) on grain yield (t/ha) with two different varieties grown under flood irrigation.

| | | *Yield* | | | *Protein* | | |
|---|---|---|---|---|---|---|---|
| **Plants/m² (actual)** | | **Aurora** | ***Vittaroi*** | ***Mean*** | ***Aurora*** | ***Vittaroi*** | ***Mean*** |
| **Aurora** | **Vittaroi** | **t/ha** | ***t/ha*** | ***t/ha*** | ***%*** | ***%*** | ***%*** |
| 83 | 72 | 9.67 ab | 8.85 d | **9.2 -** | 14.4 bcd | 15.4 a | **14.9 -** |
| 148 | 166 | 9.79 ab | 9.52 abc | **9.6 -** | 14.2 cd | 15.0 abc | ***14.6*** **-** |
| 198 | 194 | 9.96 a | 9.18 cd | **9.5 -** | 14.0 d | 14.4 bcd | ***14.2*** **-** |
| 244 | 235 | 9.67 ab | 9.26 bcd | **9.4 -** | 14.2 cd | 15.2 ab | ***14.7*** **-** |
| **Mean** | | **9.77 a** | **9.20 b** | | **14.2 b** | **15.0 a** | |

| | | |
|---|---|---|
| **LSD Cultivar p=0.05** | 0.307 | 0.413 |
| **P val** | <0.001 | <0.001 |
| **LSD Seed Rate p=0.05** | ns | ns |
| **P val** | 0.294 | 0.107 |
| **LSD Seed Rate x Cultivar. P=0.05** | 0.614 | 0.827 |
| **P val** | 0.485 | 0.719 |

**Table 4.** Influence of seeding rate on harvest Index.

| **Grain Yield (t/ha)** | | | | |
|---|---|---|---|---|
| **Sowing Rate (seeds/m²)** | 100 | 200 | 300 | 4000 |
| Harvest Index | | | | |
| **Aurora** | 0.48 - | 0.49 - | 0.47 - | 0.44 - |
| **Vittaroi** | 0.48 - | 0.58 - | 0.44 - | 0.52 - |
| $p_{var}$ = 0.035, $p_{rate}$ = 0.016, $p_{vxr}$ = 0.048, $lsd_{vxr}$ = NS, cv% = 16.2 | | | | |

Highest yield grain was from the 300 seeds/m2 rate with Aurora. No seeding rate in Aurora was significantly different. Similarly, all Vittaroi seeding rates were not statistically different.

Protein was generally lower in Aurora, with no treatment influencing protein.

Harvest Index was variable, but there was interaction between rate and variety that means analysis is not possible.

The average yield for the trial was 9.4 t/ha. This represents a WUE of 16.5 kg/mm.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Trial 3 Nitrogen Use Efficiency Trial – Nitrogen Rates

**Location:** Kerang, Victoria
**FAR Code:** ICC D20-03-2
**Sown:** 29 May 2020
**Cultivar:** DBA Vittaroi
**Harvested:** 10 December 2020
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Flood irrigation 4 applications totalling 430mm (4.3 ML/ha)
**GSR:** April-October 250mm. Total water available 680mm

***Key Messages:***

- *Relatively high soil N at sowing (130kg N/ha 0-60cm) saw the zero N control treatment (#1) accumulate 174 kg N/ha at harvest.*
- *Applied N saw increases in accumulated plant N approximating the amount applied as urea.*
- *Maximum yield was achieved by applying 300 kg N/ha split as two topdressings at GS32 and GS37.*
- *Grain protein exceeded the required 13% with 200 kg N/ha applied as a split application at GS32 and GS37.*
- *Highest grain protein was achieved with an application of 100 kg N/ha at GS55 on top of earlier applications of 200 and 250 kg N split at GS 32 and GS 55, but not significantly different to that of the 300 kg N/ha @ GS32/37 treatment.*

**Table 1:** Treatment Summary – N application rates (kg N/ha) and timing (Growth Stage).

| | Treatments | | | |
|---|---|---|---|---|
| **Intended N application** | GS30 | GS32 | GS39 | |
| **Actual stage*** | GS32 | GS 37 | GS55 | |
| **Date** | 8 September | 18 September | 4 October | Total N applied |
| **Treatment 1** | 0 | 0 | | 0 |
| **Treatment 2** | 50 | 50 | | 100 |
| **Treatment 3** | 75 | 75 | | 150 |
| **Treatment 4** | 100 | 100 | | 200 |
| **Treatment 5** | 125 | 125 | | 250 |
| **Treatment 6** | 150 | 150 | | 300 |
| **Treatment 7** | 100 | 100 | 100 | 300 |
| **Treatment 8** | 125 | 125 | 100 | 350 |

All treatments received 22 kg N/ha as starter fertiliser.
***:** Topdressing was delayed by lack of rainfall at GS30, and so further treatments were subsequently delayed.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 2.** Canopy measurements – NDVI, dry matter and accumulated plant N.

| | GS31 | | GS 65 | | Harvest | |
|---|---|---|---|---|---|---|
| **Trt** | DM (t/ha) | Accumulated N (kg N/ha) | DM (t/ha) | Accumulated N (kg N/ha) | DM (t/ha) | Accumulated N (kg N/ha) |
| **1** | 2.06 - | 80.5 - | 8.60 a | 98.9 a | 14.51 c | 174.1 d |
| **2** | | | | | 16.01 bc | 279.4 c |
| **3** | 1.94 - | 67.1 - | 10.89 b | 218.1 b | 16.59 bc | 300.3 c |
| **4** | | | | | 15.81 bc | 310.2 bc |
| **5** | | | | | 18.82 a | 363.6 a |
| **6** | 1.96 - | 68.0 - | 10.82 b | 228.9 b | 17.49 ab | 359.0 ab |
| **7** | | | | | 16.38 bc | 400.6 a |
| **8** | | | | | 17.29 ab | 376.9 a |
| **P val** | 0.461 | 0.099 | 0.004 | <0.001 | 0.026 | <0.001 |
| **LSD** | NS | NS | 1.11 | 18.49 | 2.199 | 49.5 |
| **cv%** | 6.9 | 11.2 | 6.3 | 5.9 | 9.0 | 10.5 |

Soil N at sowing was 130 kg N/ha (0-60cm). This was sufficient N to allow even canopy development until at least to GS31, as indicated by similar biomass across all treatments. However, differences were apparent at flowering where Treatment 1 had begun to suffer from reduced growth, whereas treatments 3 and 6 were similar despite double the amount of N being applied to 6.
Maximum biomass at harvest was attained by Treatment 5 (250 kg N/ha). The extra 100 kg N/ha applied to treatments 7 and 8 saw no increase in biomass over their 'sister' treatments 4 and 5 that had similar amounts of N applied up to GS 37.
Uptake of N at harvest by treatment 1 was 174 kg N/ha, which is close to expectations given 130 kg N/ha in the soil to 60 cm and 25 kg N/ha as starter fertiliser.
Highest N uptake was by treatment 7 at 400.6 kg N/ha from a total of 474 kg N/ha supplied (300 kg N/ha applied as urea plus assuming the amount of N in treatment 1 uptake (174 kg N/ha) was supplied by the soil and starter N).

**Table 3**. Yield and grain quality.

| Treatment | Grain Yield (t/ha) | Protein (%) | Screenings (%) | Test Weight (kg/hl) | Harvest Index |
|---|---|---|---|---|---|
| **1** | 7.82 d | 11.0 d | 0.6 | 82.8 | 0.48 |
| **2** | 8.73 c | 11.8 cd | 0.7 | 82.4 | 0.50 |
| **3** | 9.46 b | 12.9 bcd | 0.5 | 82.1 | 0.46 |
| **4** | 9.57 b | 13.5 abc | 0.5 | 81.9 | 0.52 |
| **5** | 9.57 b | 12.8 bcd | 0.6 | 82.5 | 0.51 |
| **6** | 10.40 a | 14.4 ab | 0.5 | 81.0 | 0.47 |
| **7** | 9.59 b | 15.1 a | 0.5 | 81.6 | 0.54 |
| **8** | 9.70 b | 15.4 a | 0.6 | 81.3 | 0.53 |
| **p** | 0.352 | <0.001 | 0.0.456 | 0.200 | 0.155 |
| **lsd** | NS | 1.885 | NS | NS | NS |

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| | | | | | |
|---|---|---|---|---|---|
| **cv%** | 12.8 | 9.6 | 33.1 | 1.2 | 8.7 |

Highest yield was attained by Treatment 6, with a total of 300 kg N/ha applied at GS32 and GS37.
As durum wheat is about meeting the minimum specification of 13% protein, Treatment 4, with a total of 200 kg N/ha applied at GS32 and GS37, was the treatment with the lowest applied N to exceed 13% protein, although it was not significantly different to treatments 2 and 3 which received 50 and 100 kg N/ha less.
Late application of 100 kg N/ha at GS55 did boost grain protein, but not significantly above that achieved with treatment 6.

While there were differences in the Harvest Index, these were not statistically significant.



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## Trial 4 Nitrogen Use Efficiency Trial – Nitrogen Timing Trial

**Location:** Kerang, Victoria
**FAR Code:** ICC D20-04-2
**Sown:** 29 May 2020
**Cultivar:** DBA Vittaroi
**Harvested:** 10 December 2020
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Flood irrigation 4 applications totalling 430mm (4.3 ML/ha)
**GSR:** April-October 250mm. Total water available 680mm

***Key Messages:***

- *No N timing strategy stood out as a clear winner.*
- *The earlier the N was applied tended to see higher biomass produced.*
- *The later the N was applied tended to see higher accumulation of N.*
- *Delayed application of nitrogen resulted in yield reduction but higher grain protein.*
- *Harvest index averaged 0.49 and was not influenced by treatment.*

**Table 1:** Treatment Summary – N application rates (kg N/ha) and timing (Growth Stage).

| **Treatments** | | | | | |
|---|---|---|---|---|---|
| **Intended N application** | Sowing | GS30 | GS32 | GS39 | |
| **Actual stage** | | GS32 | GS 37 | GS55 | |
| **Date** | 29 May | 8 September | 18 September | 4 October | Total N applied |
| **Treatment 1** | 0 | 0 | 0 | | 0 |
| **Treatment 2** | 50 | 50 | | | 100 |
| **Treatment 3** | 100 | 100 | | | 200 |
| **Treatment 4** | 150 | 150 | 0 | | 300 |
| **Treatment 5** | | 0 | 0 | | 0 |
| **Treatment 6** | | 50 | 50 | | 100 |
| **Treatment 7** | | 100 | 100 | | 200 |
| **Treatment 8** | | 150 | 150 | | 300 |
| **Treatment 9** | | | 0 | 0 | 0 |
| **Treatment 10** | | | 50 | 50 | 100 |
| **Treatment 11** | | | 100 | 100 | 200 |
| **Treatment 12** | | | 150 | 150 | 300 |

All treatments received 22 kg N/ha as starter fertiliser.
***:** Topdressing was delayed by lack of rainfall at GS30, and so all treatments were subsequently delayed.



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**Table 2**. Dry matter (t/ha) and accumulation of N (kg N/ha).

| | GS31 | | GS 65 | | Harvest | |
|---|---|---|---|---|---|---|
| **Treatment** | DM (t/ha) | Accumulated N (kg N/ha) | DM (t/ha) | Accumulated N (kg N/ha) | DM (t/ha) | Accumulated N (kg N/ha) |
| **1** | 2.27 - | 85.9 b | 9.95 b | 153.9 b | 14.45 cd | 191.2 ef |
| **2** | 2.66 - | 92.0 b | | | 16.27 bc | 236.6 de |
| **3** | 2.87 - | 115.7 a | 11.87 a | 253.8 a | 18.97 a | 282.3 cd |
| **4** | 2.75 - | 105.1 ab | | | 17.24 ab | 274.9 de |
| **5** | | | | | 13.63 d | 138.9 f |
| **6** | | | | | 15.43 bcd | 260.4 d |
| **7** | | | 9.90 b | 183.8 b | 17.61 ab | 335.4 bc |
| **8** | | | | | 16.32 bc | 342.8 bc |
| **9** | | | | | 15.61 bcd | 199.4 ef |
| **10** | | | | | 15.72 bcd | 325.0 bc |
| **11** | | | 9.90 b | 160.7 b | 15.89 bcd | 377.0 b |
| **12** | | | | | 17.17 ab | 442.8 a |
| **P val** | 0.072 | 0.033 | 0.038 | <0.001 | 0.001 | <0.001 |
| **LSD** | NS | 19.9 | 1.50 | 18.5 | 2.27 | 60.6 |
| **cv%** | 11.0 | 11.2 | 9.0 | 5.9 | 9.1 | 15.0 |

While biomass at GS 31 was not influenced by rate, accumulated N was higher in treatments 3 (100 kg N/ha) and 4 (150 kg N/ha) applied at sowing.

Dry matter assessments at GS65 showed, that at the rate of 200 kg N/ha, early application increased biomass and N accumulation.

Maximum biomass at harvest was attained by Treatment 3 (200 kg N/ha split between sowing and GS32). However this treatment was not significantly different to treatments 4 (300 kg N/ha split between sowing and GS32), 7 (200 kg N/10 split between GS 32 & GS37) and 12 (300 kg N/ha split between GS37 and GS55). Treatment 12 did have the highest N accumulation at 442.8 kg N/ha. If the amount of N available from the soil is the average of the treatments 1, 5 and 9 (where no N was applied apart from starter N at sowing) or 177 kg N/ha, then treatment 12 took up 265 kg N/ha of the applied 300 kg N.



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**Table 3a**. Influence of N timing on yield and grain quality.

| Timing | Grain Yield (t/ha) | Protein (%) | Screenings (%) | Test Weight (kg/hl) | Harvest Index |
|---|---|---|---|---|---|
| **Sowing/GS32** | 9.04 | 11.6 b | 0.5 | 82.6 | 0.48 |
| **GS32/GS37** | 9.02 | 12.1 b | 0.5 | 82.5 | 0.51 |
| **GS37/GS55** | 8.51 | 13.0 a | 0.5 | 82.1 | 0.47 |
| **P val** | * | 0.012 | 0.63 | 0.081 | 0.068 |
| **LSD** | | 0.864 | NS | NS | NS |
| **cv%** | | 9.8 | 34.1 | 0.7 | 9.9 |

*: Yield data is presented as treatment means only as there was significant interaction between N rate and timing.

**Table 3b**. Influence of N rate on yield and grain quality.

| N rate (kg N/ha) | Grain Yield (t/ha) | Protein (%) | Screenings (%) | Test Weight (kg/hl) | Harvest Index |
|---|---|---|---|---|---|
| **0** | 7.62 | 9.9 b | 0.5 | 82.6 a | 0.46 |
| **100** | 8.97 | 11.7 b | 0.5 | 82.6 a | 0..50 |
| **200** | 9.38 | 13.2 a | 0.5 | 82.2 ab | 0.48 |
| **300** | 9.45 | 14.2 a | 0.5 | 81.9 b | 0.49 |
| **P** | * | <0.001 | 0.963 | 0.022 | 0.178 |
| **LSD** | | 0.998 | NS | 0.497 | NS |
| **cv%** | | 9.8 | 34.1 | 0.7 | 9.9 |

**Table 4**. Rate by Timing results for grain yield and protein.

| | **Yield (t/ha)** | | | |
|---|---|---|---|---|
| | 0 kg N/ha | 100 kg N/ha | 200 kg N/ha | 300 kg N/ha |
| **Sowing/GS32** | 7.73 | 9.17 | 9.40 | 9.85 |
| **GS32/GS37** | 7.34 | 9.29 | 9.47 | 9.99 |
| **GS37/GS55** | 7.78 | 8.45 | 9.28 | 8.52 |
| $p_{timing}$ = 0.010, $p_{rate}$ = <0.001, $p_{txr}$ = 0.029, $lsd_{txr}$ = NS, cv% = 8.9 | | | | |

| | **Protein (%)** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 kg N/ha | | 100 kg N/ha | | 200 kg N/ha | | 300 kg N/ha | |
| **Sowing/GS32** | 10.4 | d | 10.7 | cd | 12.2 | c | 13.3 | bc |
| **GS32/GS37** | 10.0 | d | 11.9 | c | 13.2 | bc | 13.4 | bc |
| **GS37/GS55** | 9.4 | d | 12.5 | bc | 14.1 | b | 15.8 | a |
| $p_{timing}$ = 0.012, $p_{rate}$ = <0.001, $p_{txr}$ = 0.77, $lsd_{txr}$ = 1.73, cv% = 9.8 | | | | | | | | |

Yield trended higher as the rate of N was increased, but trended lower as N application was delayed. The interaction between timing and rate in the trial makes statistical analysis not possible. Logically, if the amount of N in the soil cannot sustain the crop until topdressing occurs, then yield will be compromised.



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Grain protein trended higher as the rate of N increased, as well as the later the N was applied. Given the target protein for durum wheat is 13%, early N application needed to be at the 300 kg N/ha rate, while delayed application of 200 kg N/ha split at GS32/GS37 saw grain protein exceed the 13% threshold. The highest grain protein achieved in the trial was at a N rate of 300 kg/ha and applied at the GS37/GS55 stages, but. this was at the cost of yield.

While there were differences in the Harvest Index, these were not statistically significant



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## Trial 5 Germplasm Disease Management Interaction

**Location:** Kerang, Victoria
**FAR Code:** ICC D20-07-2
**Sown:** 29 May
**Cultivar:** DBA Aurora and DBA Vittaroi
**Harvested:** 10 December 2020
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Flood irrigation 4 applications totalling 430mm (4.3 ML/ha)
**GSR:** April-October 250mm. Total water available 680mm

***Key Messages:***

- *Stripe rust was present in the trial but infection was observed in the lower canopy and not on the flag leaf.*
- *Fungicide strategy did not affect yield or grain quality.*
- *Variety choice played a role in grain quality based on higher proteins in Vittaroi.*

**Table 1.** Treatment summary – application timing, product and rate.

| Treatments | GS31 (24 August) | GS39 (21September) | GS61 (12 October) |
|---|---|---|---|
| **Untreated** | | | |
| **2 Spray** | 0.3 l/ha Prosaro | 0.4 l/ha Amistar Xtra | |
| **Systiva* + 2 Spray** | | 0.4 l/ha Amistar Xtra | 0.3 l/ha Prosaro |
| **3 Spray** | 0.4 l/ha Aviator | 0.4 l/ha Amistar Xtra | 0.3 l/ha Prosaro |
| **GS 31** | 0.4 l/ha Amistar Xtra | | |
| **GS 39** | | 0.4 l/ha Amistar Xtra | |

*Systiva applied to the seed at 150ml/100 kg seed.
The treatments were applied to DBA Aurora and DBA Vittaroi

**Table 2.** Canopy measurements – % of green leaf loss due to stripe rust infection assessed on 13 October.

| Treatments | DBA Aurora | | DBA Vittaroi | |
|---|---|---|---|---|
| | Flag Leaf | Lower canopy | Flag Leaf | Lower canopy |
| **Untreated** | 5 | 5 | 5 | 30 |
| **2 Spray** | < 5 | < 5 | < 5 | 5 |
| **Systiva + 2 Spray** | < 5 | 5 | < 5 | 10 |
| **3 Spray** | < 5 | < 5 | < 5 | < 5 |
| **GS 31** | < 5 | < 5 | 10 | 20 |
| **GS 39** | < 5 | < 5 | < 5 | 10 |

Stripe rust was first detected on the trial site on 28 August in the MS-S rated bread wheats. The durum trials were at approximately GS32 at this stage.
Conditions during September were drier than average and further infections were limited. When the assessments were conducted on 13 October, very few new infections (active sporulation) were observed.
Infection was more prevalent in the lower canopy, with all treatments showing minimal green leaf loss on the flag.



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**Table 3**. Yield and grain quality.

| Treatment | GS31 | GS39 | 2 Spray | 3 Spray | Sys+2 | Untreated |
|---|---|---|---|---|---|---|
| **Aurora** | 10.33 | 10.11 | 10.20 | 9.56 | 9.77 | 9.81 |
| **Vittaroi** | 9.39 | 9.96 | 10.10 | 10.25 | 9.59 | 9.28 |
| | $p_{var}$ = 0.242, $p_{fun}$ = 0.358, $p_{vxf}$ = 0.163, lsd $_{vxf}$ = NS, cv% = 6.0 | | | | | |
| | **Protein (%)** | | | | | |
| **Aurora** | 13.8 | 14.0 | 13.8 | 14.0 | 14.0 | 13.9 |
| **Vittaroi** | 14.8 | 15.1 | 14.9 | 14.8 | 15.1 | 14.6 |
| | $p_{var}$ = <0.001, $p_{fun}$ = 0.345, $p_{vxf}$ = 0.796, lsd $_{vxf}$ = NS, cv% = 2.5 | | | | | |

Grain yield was not influenced by either variety or fungicide strategy.
Grain protein was influenced by variety rather than fungicide strategy. It was a similar trend for test weight and screenings (not published).

The average yield for the trial was 9.86 t/ha. This represents a WUE of 14.2 kg/mm.



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## Trial 6 Disease Management for Irrigated Crops – Products, Rates and Timings

**Location:** Kerang, Victoria
**FAR Code:** ICC D20-08-2
**Sown:** 29 May
**Cultivar:** DBA Vittaroi
**Harvested:** 10 December 2020
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Flood irrigation 4 applications totalling 430mm (4.3 ML/ha)
**GSR:** April-October 250mm. Total water available 680mm

***Key Messages:***

- *Stripe rust was present in the trial but infection was observed in the lower canopy and not on the flag leaf.*
- *Fungicide strategy did not affect yield or grain quality.*

**Table 1.** Treatment summary – application timing, product and rate.

| Treatments | GS00<br>29 May | GS31<br>24 August | GS39<br>21September | GS65<br>12 October |
|---|---|---|---|---|
| **1.Untreated** | | | | |
| **2** | Systiva<br>150ml/100kg | | Prosaro<br>0.3 l/ha | |
| **3** | Jockey<br>450 ml/100kg | | Prosaro<br>0.3 l/ha | |
| **4** | Flutriafol<br>400 ml/100kg | | Prosaro<br>0.3 l/ha | |
| **5** | Vibrance<br>180 ml/100kg | Opus<br>0.5 l/ha | Prosaro<br>0.3 l/ha | |
| **6** | Vibrance<br>180 ml/100kg | Opus<br>0.5 l/ha | Aviator<br>0.4 l/ha | |
| **7** | Vibrance<br>180 ml/100kg | Radial<br>0.84 l/ha | Aviator<br>0.4 l/ha | |
| **8** | Vibrance<br>180 ml/100kg | Opus<br>0.5 l/ha | Prosaro<br>0.3 l/ha | Opus<br>0.25 l/ha |
| **9** | Vibrance<br>180 ml/100kg | Opus<br>0.5 l/ha | Aviator<br>0.4 l/ha | Opus<br>0.25 l/ha |
| **10** | Vibrance<br>180 ml/100kg | Radial<br>0.84 l/ha | Aviator<br>0.4 l/ha | Opus<br>0.25 l/ha |

***Systiva applied to the seed at 150ml/100 kg seed.

The treatments were applied to DBA Aurora and DBA Vittaroi



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 2.** Canopy measurements – % of green leaf loss assessed on 13 October.

| Treatments | Visual Assessment 13 October | | NDVI 15 November |
|---|---|---|---|
| | Flag Leaf | Lower canopy | NDVI |
| **1 Untreated** | 10 | 40 | 0.53 d |
| **2** | 5 | 10 | 0.62 ab |
| **3** | < 5 | 10 | 0.60 bc |
| **4** | < 5 | 5 | 0.61 ab |
| **5** | < 5 | 5 | 0.55 cd |
| **6** | < 5 | 5 | 0.63 ab |
| **7** | < 5 | 5 | 0.60 b |
| **8** | < 5 | < 5 | 0.61 b |
| **9** | < 5 | 5 | 0.59 bc |
| **10** | < 5 | 5 | 0.66 a |
| | | | $p_{ndvi}$ = 0.001, lsd = 0.055, cv% = 6.3 |

Stripe rust was first detected on the trial site on 28 August in the MS-S rated bread wheats. The durum trials were at approximately GS32 at this stage.
Conditions during September were drier than average and further infections were limited. When the assessments were conducted on 13 October, very few new infections (active sporulation) were observed.
Infection was more prevalent in the lower canopy, with all treatments showing minimal green leaf loss on the flag.
NDVI assessment on 15 November saw some differences in canopy 'greenness', with the treatment 10 having the highest NDVI reading and the untreated, the lowest.

**Table 3**. Yield and grain quality.

| Treatment | Yield (t/ha) | Protein (%) | Screenings (%) | Test Weight (kg/hl) |
|---|---|---|---|---|
| **1 Untreated** | 9.56 | 15.1 | 0.5 | 79.7 |
| **2** | 10.49 | 15.5 | 0.5 | 79.9 |
| **3** | 10.49 | 15.4 | 0.5 | 80.0 |
| **4** | 10.13 | 14.9 | 0.4 | 80.7 |
| **5** | 9.81 | 15.1 | 0.4 | 79.6 |
| **6** | 10.22 | 15.0 | 0.4 | 80.5 |
| **7** | 10.28 | 15.2 | 0.5 | 80.6 |
| **8** | 10.46 | 15.3 | 0.5 | 80.3 |
| **9** | 10.17 | 15.2 | 0.4 | 80.2 |
| **10** | 10.55 | 15.3 | 0.5 | 80.5 |
| P val | 0.099 | 0.555 | 0.948 | 0.533 |
| LSD | NS | NS | NS | NS |
| cv% | 4.6 | 2.3 | 38.4 | 1.0 |

Grain yield was not influenced by fungicide strategy.

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The average yield for the trial was 10.2 t/ha. This represents a WUE of 15.0 kg/mm



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## Trial 7 Influence of Plant Growth Regulation on Durum Yield and Profitability under Irrigation

**Location:** Kerang, Victoria
**FAR Code:** ICC D20-09-2
**Sown:** 29 May
**Cultivar:** DBA Aurora
**Harvested:** 10 December 2020
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Flood irrigation 4 applications totalling 430mm (4.3 ML/ha)
**GSR:** April-October 250mm. Total water available 680mm

***Key Messages:***

- *Some of the trial treatments did result in reduced plant height but this did not necessarily result in reduced lodging.*
- *Grazing was not effective in reducing crop height but yield was similar to the highest yielding treatment.*
- *Application of PGRs at label rates, either as a single or split application resulted in the highest yields.*
- *There was some variation in grain protein due to the treatments but not enough to affect DR1 classification.*

**Table 1.** Treatment summary – application timing, product and rate.

| Treatments | GS30 | GS31-32 | GS32 | GS37 | GS39 |
|---|---|---|---|---|---|
| **1 Untreated** | | | | | |
| **2** | | E 1.3 l/ha<br>M E 0.2 l/ha | | | |
| **3** | E 0.65 l/ha<br>M E 0.1 l/ha | | E 0.65 l/ha<br>M E 0.1 l/ha | | |
| **4** | E 1.3 l/ha | | M E 0.2 l/ha | | |
| **5** | E 0.65 l/ha | | M E 0.1 l/ha | | |
| **6** | | E 1.3 l/ha<br>M E 0.2 l/ha | | | PGR 0.75l/ha |
| **7** | E 0.65 l/ha<br>M E 0.1 l/ha | | E 0.65 l/ha<br>M E 0.1 l/ha | PGR 0.75l/ha | |
| **8** | | | | | PGR 0.75l/ha |
| **9** | | | Grazed<br>GS22&32 | | |
| **10** | | | E 1.3 l/ha | | PGR 0.75l/ha |

E = Errex 750 582 g/l chlormequat
M E = Modus Evo 250 g/l trinexapac-ethyl
PGR = Product not registered for use in Australia on wheat



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**Table 2.** Canopy measurements – Plant height on 13 October and lodging score assessed on 10 December.

| Treatments | Plant Height (cm) | Lodging Score |
|---|---|---|
| **1 Untreated** | 100 a | 4.5 |
| **2** | 83 ef | 5.0 |
| **3** | 81 f | 4.0 |
| **4** | 86 de | 4.5 |
| **5** | 98 ab | 5.0 |
| **6** | 81 f | 4.5 |
| **7** | 84 ef | 4.5 |
| **8** | 98 ab | 6.0 |
| **9** | 91 cd | 5.3 |
| **10** | 95 bc | 6.0 |
| P val | <0.001 | 0.63 |
| LSD | 4.52 | NS |
| cv% | 4.0 | 30.5 |

Lodging Score - 0 = no lodging, 9 = Completely lodged

In relation to reducing crop height, treatment 6 was the most effective, with treatments 2, 3 and 7 being statistically similar.

Treatments 1, 5 and 8 were least effective.

However no treatment was effective in controlling lodging, with the data being highly variable.

**Table 3**. Yield and grain quality.

| Treatments | Yield (t/ha) | Protein (%) | Screenings (%) | Test Weight (kg/hl) |
|---|---|---|---|---|
| **1 Untreated** | 7.61 d | 14.2 ab | 1.1 | 80.7 |
| **2** | 9.49 ab | 14.5 a | 0.9 | 80.7 |
| **3** | 9.59 ab | 14.2 ab | 1.1 | 81.1 |
| **4** | 9.65 a | 14.1 ab | 1.1 | 81.0 |
| **5** | 8.17 cd | 14.2 ab | 0.8 | 80.5 |
| **6** | 9.64 a | 14.1 ab | 1.0 | 80.0 |
| **7** | 8.95 abc | 14.0 b | 1.0 | 80.1 |
| **8** | 7.81 d | 13.9 b | 1.0 | 79.7 |
| **9** | 8.61 abcd | 13.7 b | 1.1 | 80.7 |
| **10** | 8.53 bcd | 14.2 ab | 1.1 | 80.5 |
| p | 0.001 | 0.048 | 0.627 | 0.334 |
| lsd | 1.08 | 0.428 | NS | NS |
| cv% | 8.5 | 2.1 | 22.6 | 1.0 |

Highest yield was from treatment 4, statistically similar to treatments 2, 3, 6, 7 and 9.

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While protein was influenced by treatments, all protein levels were sufficient to meet DR1 specification.
Screenings and test weight were not affected by treatment.



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Optimising Irrigated Grains

# Optimising Irrigated Grains (FAR1906-003RTX)

**A Grains Research & Development Corporation (GRDC) investment**

## PROVISIONAL HARVEST RESULTS:

# Irrigated Canola Trials

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The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

# Finley Irrigated Research Centre NSW

*Irrigated trials conducted at the Finley irrigated research centre 2020 were managed by FAR Australia, hosted by Southern Growers.*

## Trial 1 Optimum Plant Population Under Overhead Irrigation

**Project objective:** To compare identical plant population x cultivar canola trials under overhead and flood irrigation

**Location:** Finley IRC
**FAR Code:** FAR C20-01-1
**Sown:** 28 April 2020
**Cultivar:** HyTTec® Trophy and 45Y28 RR
**Harvested:** 27th November 2020
**Rotation position:** Wheat (2019), Faba beans (2018), Fallow after rice (2017)
**Soil Management:** Wheat stubble incorporated with speed disc in Autumn
**Irrigation:** Overhead lateral irrigation 5 x 25mm in spring. Total applied 125mm
**GSR:** April-October 244mm. Total water available 369mm
Available Soil N: 129 kg N/ha (0 – 90cm)

**Key Messages:**

- *Under overhead irrigation there was a significant interaction between plant population and cultivar*
- *With the 45Y28 RR hybrid there was no significant difference in yield (4.05 – 4.27t/ha) between 14 – 36 plants/m$^2$.*
- *With HyTTec® Trophy a maximum yield of 3.92 t/ha was achieved at the highest plant population achieved (approximately 30 plants/m$^2$ (sown at 80 seeds/m$^2$).*
- *There was relatively poor establishment following incorporated wheat stubble with 35-50% establishment in both cultivars.*
- *When both cultivars were averaged there was significant advantage in dry matter (DM) at 20% flowering with plant populations over 15plants/m2.*
- *At harvest the DM content of the 45Y28 RR canopy averaged 14.36t/ha (all populations no significant difference) with a harvest index (%) of 25.6% (range 23.4 – 28.1%) (data not shown only available with 45Y28 RR).*
- *Thinner crops resulting from the lowest plant populations were reflected in lower crop reflectance scores (NDVI measured with a Greenseeker) up until flowering.*
- *The oil content of RR45Y28 RR was significantly higher than HyTTec® Trophy (42.7 v 41.9).*
- *WUE based on average yield of 45Y28 of 4.05t/ha was 15.6.*

The trial establishment was between 35-50% and generated yields of HyTTec® Trophy between 3.18-3.92 t/ha and 45Y28 RR 3.69 – 4.27t/ha (Table 1 & 2). The RR hybrid gave similar yields between 14 – 36 plants/m$^2$ whilst yields of the TT hybrid were maximised at 30 plants/m$^2$ (see also Trial 6 where the same hybrid responded to 50 plants/m$^2$).



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 1.** Influence of plant population and cultivar on grain yield (t/ha) grown under overhead irrigation.

| | | Yield t/ha | | |
|---|---|---|---|---|
| **Plants/m2 (actual)** | | **HyTTec® Trophy** | **45Y28 RR** | **Mean** |
| **Trophy** | **45Y28** | **(Hybrid TT)** | **(RR Y Series Hybrid)** | **Yield t/ha** |
| 10 | 10 | 3.18 e | 3.69 cd | **3.44 c** |
| 20 | 14 | 3.34 e | 4.17 ab | **3.75 b** |
| 18 | 23 | 3.63 d | 4.27 a | **3.95 a** |
| 29 | 36 | 3.92 bc | 4.05 ab | **3.99 a** |
| **Mean** | | **3.52 b** | **4.05 a** | |

| | | | |
|---|---|---|---|
| **LSD Seed Rate p = 0.05** | 0.18 t/ha | **P val** | <0.001 |
| **LSD Cultivar p=0.05** | 0.18 t/ha | **P val** | 0.006 |
| **LSD Seed Rate x Cultivar.** | 0.25 t/ha | **P val** | 0.023 |

**Table 2.** Establishment - Plant population (plants/$m^2$) established from four seed rates with two different cultivars grown under overhead irrigation.

| | Established Population | | |
|---|---|---|---|
| **Seed Rate** | **HyTTec® Trophy** | **45Y28 RR** | **Mean** |
| | (Hybrid TT) | (RR Y Series Hybrid) | |
| | **Plants/$m^2$** | **Plants/$m^2$** | **Plants/$m^2$** |
| **20 seeds/$m^2$** | 9.5 - | 9.8 - | **9.6 c** |
| **40 seeds/$m^2$** | 20.0 - | 14.0 - | **17.0 bc** |
| **60 seeds/$m^2$** | 17.8 - | 23.0 - | **20.4 b** |
| **80 seeds/$m^2$** | 29.3 - | 35.8 - | **32.5 a** |
| **Mean** | **19.1 -** | **20.6 -** | |

| | | | |
|---|---|---|---|
| **LSD Seed Rate p = 0.05** | 8.4 | **P val** | <0.001 |
| **LSD Cultivar p=0.05** | ns | **P val** | 0.7993 |
| **LSD Seed Rate x Cultivar.** | ns | **P val** | 0.4103 |

*RR – Roundup Ready Hybrid*

**Table 3.** Influence of plant population and cultivar on seed oil content (%) grown under overhead irrigation.

| | | Oil content (%) | | |
|---|---|---|---|---|
| **Plants/$m^2$ (actual)** | | **HyTTec® Trophy** | **45Y28 RR** | **Mean** |
| **Trophy** | **45Y28** | (Hybrid TT) | (RR Y Series Hybrid) | **Oil %** |
| 10 | 10 | 41.6 c | 43.0 a | 42.3 - |
| 20 | 14 | 42.5 ab | 42.7 a | 42.6 - |
| 18 | 23 | 41.6 c | 43.1 a | 42.4 - |
| 29 | 36 | 42.0 bc | 42.0 bc | 42.0 - |
| **Mean** | | **41.9 b** | **42.7 a** | |

| | | | |
|---|---|---|---|
| **LSD Plant Population p = 0.05** | 0.48 | **P val** | 0.089 |
| **LSD Cultivar p=0.05** | 0.39 | **P val** | 0.009 |
| **LSD Seed Rate x Cultivar.** | 0.68 | **P val** | 0.008 |

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**Table 4.** Influence of plant population and cultivar on dry matter (t/ha) at early flowering (GS62) grown under overhead irrigation.

| | | Dry Matter t/ha at GS62 | | |
|---|---|---|---|---|
| **Plants/m² (actual)** | | Plants/m² (actual) | **45Y28 RR** | **Mean** |
| **Trophy** | **45Y28** | (Hybrid TT) | (RR Y Series Hybrid) | **t/ha** |
| 10 | 10 | 2.87 - | 3.43 - | 3.15 b |
| 20 | 14 | 3.51 - | 4.96 - | 4.23 a |
| 18 | 23 | 4.72 - | 4.81 - | 4.77 a |
| 29 | 36 | 4.48 - | 5.68 - | 5.08 a |
| **Mean** | | **3.90 -** | **4.72 -** | |

| | | | |
|---|---|---|---|
| **LSD Seed Rate p = 0.05** | 1.07 | **P val** | 0.007 |
| **LSD Cultivar p=0.05** | 0.96 | **P val** | 0.071 |
| **LSD Seed Rate x Cultivar** | ns | **P val** | 0.549 |

**Table 5.** Influence of plant population and cultivar on dry matter (t/ha) at harvest grown under overhead irrigation.

| | | Dry Matter t/ha at harvest | |
|---|---|---|---|
| **Seedrate** | Plants/m² | **HyTTec® Trophy** | **45Y28 RR** |
| | | (Hybrid TT) | (RR Y Series Hybrid) |
| **20 seeds/m²** (10,10) | | - | 14.53 - |
| **40 seeds/m²** (20, 14) | | - | 15.14 - |
| **60 seeds/m²** (18, 23) | | 13.64 - | 13.97 - |
| **80 seeds/m²** (29, 36) | | - | 14.51 - |
| **Mean** | | | **14.36** |

| | | | |
|---|---|---|---|
| **LSD Seed Rate p = 0.05** | ns | **P val** | 0.898 |

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## Trial 2 Optimum Plant Population Under Flood Irrigation

**Project objective: To compare identical plant population x cultivar canola trials under overhead and flood irrigation**

**Location:** Finley IRC
**FAR Code:** FAR C20-01-2
**Sown:** 28 April
**Cultivar:** HyTTec® Trophy and 45Y28 RR
**Harvested:** 27th November 2020
**Rotation position:** Wheat (2019), Faba bean (2018) Wheat (2017)
**Soil Management:** Wheat stubble incorporated with speed disc in Autumn
**Irrigation:** Flood irrigation 3 x 80mm in spring. Total applied 240mm (2.4 ML/ha)
**GSR:** April- October 244mm. Total water available 484mm
Available Soil N: 214 kg N/ha (0 – 90cm)

**Key Messages:**

- *Under flood irrigation and with higher available soil N (214 kg N/ha 0-90cm) seed yields were significantly higher with 45Y28 RR than HyTTec® Trophy with both cultivars maximising yield at higher plant populations tested (45Y28 RR - 4.9t/ha (32plants/m$^2$),* HyTTec® *Trophy- 4.01 - 4.11t/ha (23-31 plants/m$^2$)).*
- *At 20% flowering 45Y28 RR was associated with significant higher dry matter production (4.51t/ha compared to 3.3t/ha with the TT hybrid).*
- *Yields cannot be statistically compared in these identical trials on flood and under lateral (Trial 1 & Trial 2) but yields on flood were approximately 0.4 & 0.2t/ha (valued at $240 & $120/ha at $600/t)) higher yielding (depending on hybrid) at equivalent seed rates for the use of 1.15MegaL/ha more water.*
- *Establishment was poor due to heavy rain after sowing with between 30-50% plant establishment.*
- *As yield increased with higher plant population oil content showed a very slight decline (p=0.059) of less than 1%, but there no difference between cultivars.*
- *The highest yielding treatments were associated with the highest dry matter (4.96t/ha) at 20% flowering.*
- *Dry matter assessed at harvest was conducted only at the 60seeds/m$^2$and revealed a harvest dry matter of 13.05t/ha with 45Y28 RR and 12.34t/ha with HyTTec® Trophy, leading to a harvest index of 31% and 30% respectively (data not shown).*
- *WUE based on an average yield of 45Y28 of 4.49t/ha was 12kg/mm.*

**Table 1.** Influence of plant population and cultivar on grain yield (t/ha) grown with flood irrigation.

| | | Yield t/ha | | |
|---|---|---|---|---|
| **Plants/m$^2$ (actual)** | | **HyTTec® Trophy** | **45Y28 RR** | **Mean** |
| **Trophy** | **45Y28** | (Hybrid TT) | (RR Y Series Hybrid) | **Yield t/ha** |
| 12 | 11 | 3.37 - | 4.04 - | **3.70 c** |
| 15 | 21 | 3.76 - | 4.58 - | **4.17 b** |
| 31 | 18 | 4.01 - | 4.42 - | **4.22 b** |
| 24 | 32 | 4.11 - | 4.90 - | **4.50 a** |
| **Mean** | | **3.81 b** | **4.49 a** | |

| | | | |
|---|---|---|---|
| **LSD Plant Population p = 0.05** | 0.24 | **P val** | 0.003 |
| **LSD Cultivar p=0.05** | 0.18 | **P val** | <0.001 |
| **LSD Seed Rate x Cultivar.** | ns | **P val** | 0.433 |

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**Table 2.** Establishment - Plant population (plants/m$^2$) established from four seed rates with two different cultivars grown under overhead irrigation.

| | Established Population | | | | | |
|---|---|---|---|---|---|---|
| **Seed Rate** | **HyTTec® Trophy** | | **45Y28 RR** | | **Mean** | |
| | **Plants/m$^2$** | | **Plants/m$^2$** | | **Plants/m$^2$** | |
| **20 seeds/m$^2$** | 12.3 | de | 10.8 | e | **11.5** | **c** |
| **40 seeds/m$^2$** | 15.3 | cde | 20.5 | bc | **17.9** | **b** |
| **60 seeds/m$^2$** | 31 | a | 18.5 | bcd | **24.8** | **a** |
| **80 seeds/m$^2$** | 23.5 | b | 32.3 | a | **27.9** | **a** |
| **Mean** | **20.5** | **-** | **20.5** | **-** | | |

| | | | |
|---|---|---|---|
| **LSD Plant Population p = 0.05** | 5.12 | **P val** | <0.001 |
| **LSD Cultivar p=0.05** | ns | **P val** | 1.000 |
| **LSD Seed Rate x Cultivar.** | 7.24 | **P val** | 0.011 |

**Table 3.** Influence of plant population and cultivar on seed oil content (%) grown with flood irrigation.

| | | Oil content (%) | | | |
|---|---|---|---|---|---|
| **Plants/m$^2$ (actual)** | | **HyTTec® Trophy** | **45Y28 RR** | **Mean** | |
| **Trophy** | **45Y28** | (Hybrid TT) | (RR Y Series Hybrid) | **Oil %** | |
| 12 | 11 | 41.8 - | 42.0 - | **41.9** | **-** |
| 15 | 21 | 41.6 - | 42.0 - | **41.8** | **-** |
| 31 | 18 | 41.5 - | 41.4 - | **41.4** | **-** |
| 24 | 32 | 41.5 - | 40.9 - | **41.2** | **-** |
| **Mean** | | **41.6 -** | **41.6 -** | | |

| | | | |
|---|---|---|---|
| **LSD Plant Population p = 0.05** | 0.51 | **P val** | 0.059 |
| **LSD Cultivar p=0.05** | ns | **P val** | 0.873 |
| **LSD Seed Rate x Cultivar.** | ns | **P val** | 0.229 |

**Table 4.** Influence of plant population and cultivar on dry matter at early flowering (GS62) grown with flood irrigation.

| | | Dry Matter (t/ha) at GS62 | | | |
|---|---|---|---|---|---|
| **Plants/m$^2$ (actual)** | | **HyTTec® Trophy** | **45Y28 RR** | **Mean** | |
| **Trophy** | **45Y28** | (Hybrid TT) | (RR Y Series Hybrid) | **t/ha** | |
| 12 | 11 | 2.64 - | 3.85 - | **3.24** | **-** |
| 15 | 21 | 3.11 - | 4.90 - | **4.01** | **-** |
| 31 | 18 | 3.77 - | 4.32 - | **4.04** | **-** |
| 24 | 32 | 3.67 - | 4.96 - | **4.32** | **-** |
| **Mean** | | **3.30 b** | **4.51 a** | | |

| | | | |
|---|---|---|---|
| **LSD Seed Rate p = 0.05** | 0.77 | **P val** | 0.051 |
| **LSD Cultivar p=0.05** | 0.54 | **P val** | 0.006 |
| **LSD Seed Rate x Cultivar.** | ns | **P val** | 0.432 |

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**Table. 5** Normalised differential vegetation index (NDVI) of two cultivars at 4 seed rates.

| | NDVI (0-1) | | | |
|---|---|---|---|---|
| **Plant Population & Cultivar** | **GS16** | **GS50** | **GS52** | **GS66** |
| **HyTTec® Trophy** | | | | |
| 12 plants/m$^2$ | 0.17 - | 0.48 d | 0.48 d | 0.57 - |
| 15 plants/m$^2$ | 0.17 - | 0.54 c | 0.55 c | 0.59 - |
| 31 plants/m$^2$ | 0.21 - | 0.68 b | 0.70 b | 0.61 - |
| 24 plants/m$^2$ | 0.20 - | 0.68 b | 0.68 b | 0.59 - |
| **45Y28 RR** | | | | |
| 11 plants/m$^2$ | 0.17 - | 0.57 c | 0.56 c | 0.60 - |
| 21 plants/m$^2$ | 0.19 - | 0.71 b | 0.71 ab | 0.59 - |
| 18 plants/m$^2$ | 0.20 - | 0.73 ab | 0.72 ab | 0.57 - |
| 32 plants/m$^2$ | 0.22 - | 0.77 a | 0.76 a | 0.59 - |
| | | | | |
| **Mean** | **0.19** | **0.64** | **0.64** | **0.59** |
| **LSD Seed Rate x Cultivar.** | ns | 0.06 | 0.05 | ns |
| **P val** | 0.168 | 0.033 | 0.009 | 0.571 |



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## Trial 3 Nitrogen Use Efficiency Trial – Nitrogen Rates

**Project Objective:** To examine at the nitrogen use efficiency of canola grown under overhead irrigation

**Location:** Finley IRC **FAR Code:** FAR C20-04-1

**Sown:** 27 April **Cultivar:** 45Y28 RR

**Harvested:** 27th November 2020

**Rotation position:** Wheat (2019), Faba beans (2018), Fallow after rice (2017)

**Soil Management:** Wheat stubble incorporated with speed disc in Autumn

**Irrigation:** Overhead lateral irrigation 6 x 25mm in spring. Total applied 150mm

**GSR:** April-October 244mm. Total water available 394mm

Available Soil N: 129 kg N/ha (0 – 90cm)

**Key Messages:**

- *Following wheat, the hybrid 45Y28 RR gave a significant response to applied nitrogen that illustrated an optimum N rate for yield of approximately 160kg N/ha.*
- *There was no significant difference in seed yield between 160 – 320kg N/ha applied in this rotation position with 0.16t/ha covering the difference between the higher N rates.*
- *Differences in oil content were small but significant with a 1.2% oil content decline covering N rates between 80 – 320 N applied.*
- *At early flowering the unfertilised crop canopy had removed 137kg N/ha and had an average dry matter content of 5.5 t/ha compared to just over 300kg N/ha uptake and 7t/ha dry matter where the highest rate of N was applied, however the differences in DM were not significant.*
- *The optimum N rate of 160kg N/ha had removed approximately 238kg N/ha at the 20% flower stage indicating that approximately 110kg N/ha had been utilised if soil N supply (0-90cm) was assumed to be 100% efficient.*
- *At harvest there was no significant difference between dry matter (DM) content with an average DM of 15.5t/ha. Variable plant tissue analysis precluded detailed analysis of N offtake at harvest.*
- *The unfertilised crop removed 123 kg of N/ha at compared up to 310 kg/ha where the highest rate of N was applied.*

**Table 1.** Influence of applied nitrogen fertiliser rate (split 50:50) at six leaf (6L) & Green bud (GB) on seed yield (t/ha) and oil content (%).

| Nitrogen Treatment Rate & Timing | | Total Nitrogen N/ha | Grain yield and quality Yield t/ha | | Oil % | |
|---|---|---|---|---|---|---|
| **1.** | 0kg N/ha | 0 | 3.91 | d | 43.0 | ab |
| **2.** | 40kg N/ha@6L & 40kg N/ha@GB | 80 | 4.30 | c | 43.3 | a |
| **3.** | 60kg N/ha@6L & 60kg N/ha@GB | 120 | 4.41 | bc | 42.0 | d |
| **4.** | 80kg N/ha@6L & 80kg N/ha@GB | 160 | 4.55 | ab | 42.4 | bcd |
| **5.** | 100kg N/ha@6L & 100kg N/ha@GB | 200 | 4.59 | ab | 42.4 | bcd |
| **6.** | 120kg N/ha@6L & 120kg N/ha@GB | 240 | 4.62 | a | 42.8 | a-d |
| **7.** | 140kg N/ha@6L & 140kg N/ha@GB | 280 | 4.71 | a | 42.9 | abc |
| **8.** | 160kg N/ha@6L & 160kg N/ha@GB | 320 | 4.71 | a | 42.1 | cd |
| | **Mean** | | **4.475** | | **42.6** | |
| | **LSD** | | 0.19 | | 0.84 | |
| | **P val** | | <0.001 | | 0.032 | |

N applied as prilled Urea (46% N content)



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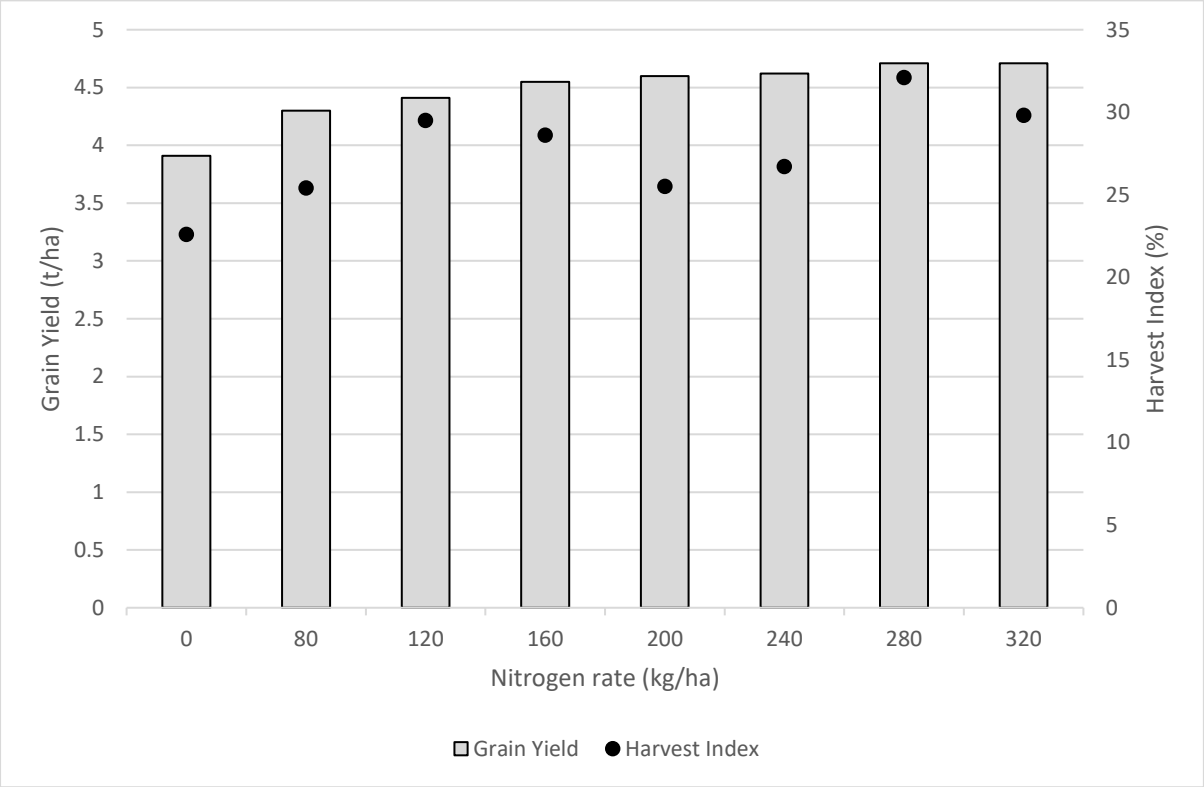


**Figure 1.** Influence of applied N rate on seed yield (t/ha) and harvest index (%).

**Table 2.** Influence of applied nitrogen rate at six leaf (6L) & Green bud (GB) on dry matter and N offtake at harvest.

| Nitrogen Treatment Rate & Timing | | Total | Dry matter & N offtake | |
|---|---|---|---|---|
| | | Nitrogen | Dry Matter | N removed |
| | | N/ha | Kg/ha | Kg N/ha |
| **1.** | 0kg N/ha | 0 | 16.1 - | 123 c |
| **2.** | 40kg N/ha@6L & 40kg N/ha@GB | 80 | 15.8 - | 159 c |
| **3.** | 60kg N/ha@6L & 60kg N/ha@GB | 120 | 14.7 - | 153 c |
| **4.** | 80kg N/ha@6L & 80kg N/ha@GB | 160 | 15.0 - | 288 ab |
| **5.** | 100kg N/ha@6L & 100kg N/ha@GB | 200 | 17.1 - | 171 bc |
| **6.** | 120kg N/ha@6L & 120kg N/ha@GB | 240 | 15.9 - | 164 c |
| **7.** | 140kg N/ha@6L & 140kg N/ha@GB | 280 | 14.7 - | 174 bc |
| **8.** | 160kg N/ha@6L & 160kg N/ha@GB | 320 | 15.0 - | 310 a |
| | **Mean** | | **15.5** | **193** |
| | **LSD** | | 4.52 | 123 |
| | **P Val** | | 0.9432 | 0.041 |

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**Table 3.** Influence of applied nitrogen rate at six leaf (6L) & Green bud (GB) on dry matter offtake at 20% flowering.

| Nitrogen Treatment Rate & Timing | | Total | Dry matter & N offtake | |
|---|---|---|---|---|
| | | Nitrogen | Dry Matter | N removed |
| | | N/ha | Kg/ha | Kg N/ha |
| **1.** | 0kg N/ha | 0 | 5.53 - | 137 c |
| **2.** | 40kg N/ha@6L & 40kg N/ha@GB | 80 | 5.98 - | 198 bc |
| **3.** | 60kg N/ha@6L & 60kg N/ha@GB | 120 | 6.53 - | 229 b |
| **4.** | 80kg N/ha@6L & 80kg N/ha@GB | 160 | 6.49 - | 238 b |
| **5.** | 100kg N/ha@6L & 100kg N/ha@GB | 200 | 5.49 - | 237 b |
| **6.** | 120kg N/ha@6L & 120kg N/ha@GB | 240 | 6.41 - | 234 b |
| **7.** | 140kg N/ha@6L & 140kg N/ha@GB | 280 | 6.03 - | 260 ab |
| **8.** | 160kg N/ha@6L & 160kg N/ha@GB | 320 | 7.07 - | 304 a |
| | **Mean** | | **6.19** | **229** |
| | **LSD** | | ns | 65 |
| | **P val** | | 0.489 | 0.002 |



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## Trial 4 Nitrogen Use Efficiency Trial – Nitrogen Timing Trial

**Protocol Objective:** To assess whether the optimum timing for applied N interacts with N rate under overhead irrigation
**Sown:** 28 April
**Cultivar:** Nuseed Diamond
**Harvested:** 27th November 2020
**Rotation position:** Wheat (2019), Faba beans (2018), Fallow after rice (2017)
**Soil Management:** Wheat stubble incorporated with speed disc in Autumn
**Irrigation:** Overhead lateral irrigation 6 x 25mm in spring. Total applied 150mm
**GSR:** April-October 244mm. Total water available 394mm
Available Soil N: 126 kg N/ha (0 – 90cm)

**Key Messages:**

- *Different N timing strategies had no significant effect on seed yield irrespective of N rate applied (120, 240, 360 kg N/ha) cv Nuseed Diamond*
- *Applied N fertiliser significantly increased yield over the unfertilised crop but there was no significant difference between applied N rates of 120 – 360kg N/ha.*
- *Dry matter production at harvest indicated no significant differences due to either N rate or timing.*
- *N offtake at harvest was higher as more N was applied up to 240 Kg N/ha and was significantly greater when N was timed later in the growing season*
- *N offtake was higher when applied at the late timing strategy (green bud & yellow bud) than when applied at the earlier timing strategies*

**Table 1.** Influence of N rate and timing strategies on seed yield (t/ha) on canola grown under overhead irrigation cv Nuseed Diamond.

| | Nitrogen Application Rate | | | |
|---|---|---|---|---|
| | **0kg/ha N** | **120kg/ha N** | **240kg/ha N** | **360kg/ha N** |
| **Nitrogen Timing** | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** |
| PSPE & 6 - Leaf | 4.08 - | 4.35 - | 4.51 - | 4.35 - |
| 6-Leaf & Green Bud | 4.03 - | 4.41 - | 4.64 - | 4.38 - |
| Green Bud & Yellow | 3.74 - | 4.26 - | 4.45 - | 4.54 - |
| **Mean** | **3.95 b** | **4.34 a** | **4.53 a** | **4.43 a** |
| | | | | |
| **LSD N Application Timing p = 0.05** | | ns | **P val** | 0.626 |
| **LSD N Application Rate p=0.05** | | 0.20 | **P val** | <0.001 |
| **LSD N Timing. x N Rate. P=0.05** | | ns | **P val** | 0.592 |

*PSPE – Post sow pre-emergence application - broadcast*
*In addition to N rates specified a standard MAP application meant that all treatments received 12 kg N/ha at sowing.*



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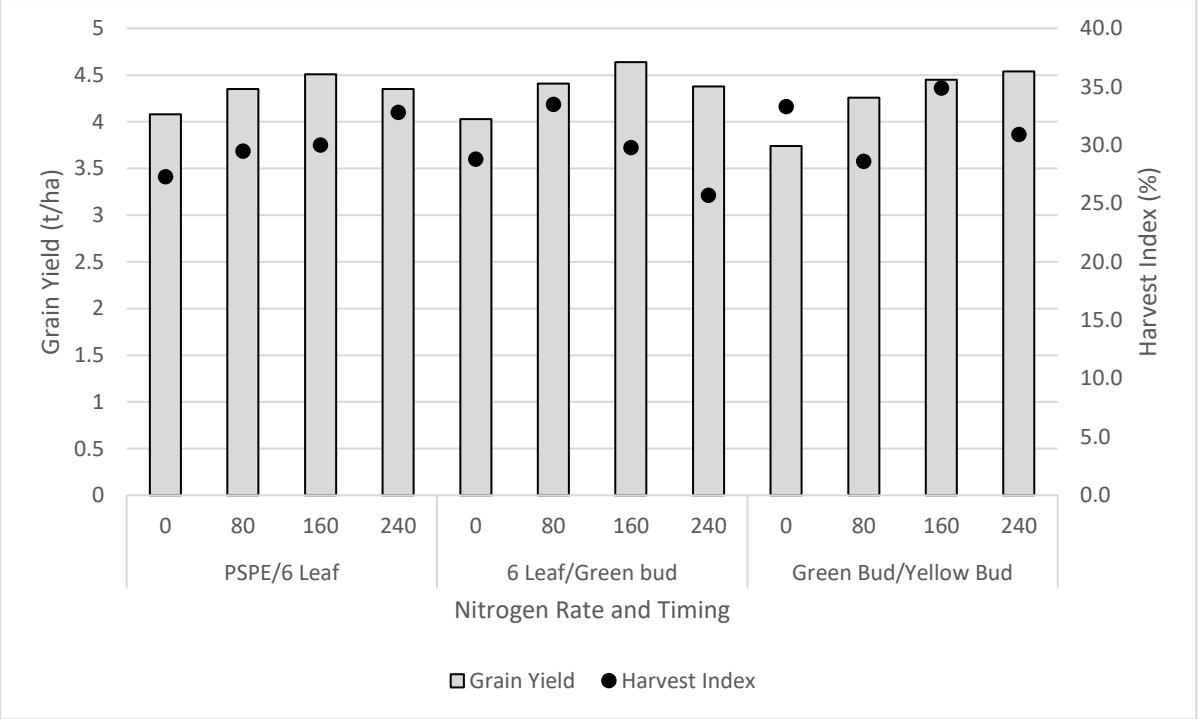


**Figure 1.** Influence of applied N rate and timing on grain yield (t/ha) and harvest index (%).

**Table 2.** Influence of N timing and rate (kg N/ha) on N removal in the crop canopy at early flowering.

| | Nitrogen removed at GS63 (kg N/ha) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0kg/ha N** | | **120kg/ha N** | | **240kg/ha N** | | **360kg/ha N** | | **Mean** | |
| **Nitrogen Timing** | | | | | | | | | | |
| PSPE & 6 - Leaf | 118 | - | 120 | - | 240 | - | 132 | - | **152** | - |
| 6-Leaf & Green Bud | 162 | - | 174 | - | 200 | - | 146 | - | **171** | - |
| Green Bud & Yellow Bud | 146 | - | 153 | - | 144 | - | 171 | - | **153** | - |
| **Mean** | **142** | **b** | **149** | **b** | **194** | **a** | **150** | **b** | | |
| | | | | | | | | | | |
| **LSD N Application Timing p = 0.05** | | | ns | | | | **P val** | | 0.284 | |
| **LSD N Application Rate p=0.05** | | | 36 | | | | **P val** | | 0.071 | |
| **LSD N Timing. x N Rate. P=0.05** | | | ns | | | | **P val** | | 0.136 | |

**Table 3.** Influence of N timing and rate (kg N/ha) on N removal in the crop canopy at harvest.

| | Nitrogen removed at harvest (kg N/ha) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0kg/ha N** | | **120kg/ha N** | | **240kg/ha N** | | **360kg/ha N** | | **Mean** | |
| **Nitrogen Timing** | | | | | | | | | | |
| PSPE & 6 - Leaf | 75 | - | 151 | - | 199 | - | 189 | - | **154** | **b** |
| 6-Leaf & Green Bud | 96 | - | 81 | - | 167 | - | 149 | - | **123** | **b** |
| Green Bud & Yellow Bud | 141 | - | 260 | - | 284 | - | 251 | - | **234** | **a** |
| **Mean** | **104** | **c** | **164** | **b** | **217** | **a** | **196** | **ab** | | |
| | | | | | | | | | | |
| **LSD N Application Timing p = 0.05** | | | 48 | | | | **P val** | | 0.004 | |
| **LSD N Application Rate p=0.05** | | | 36 | | | | **P val** | | <0.001 | |

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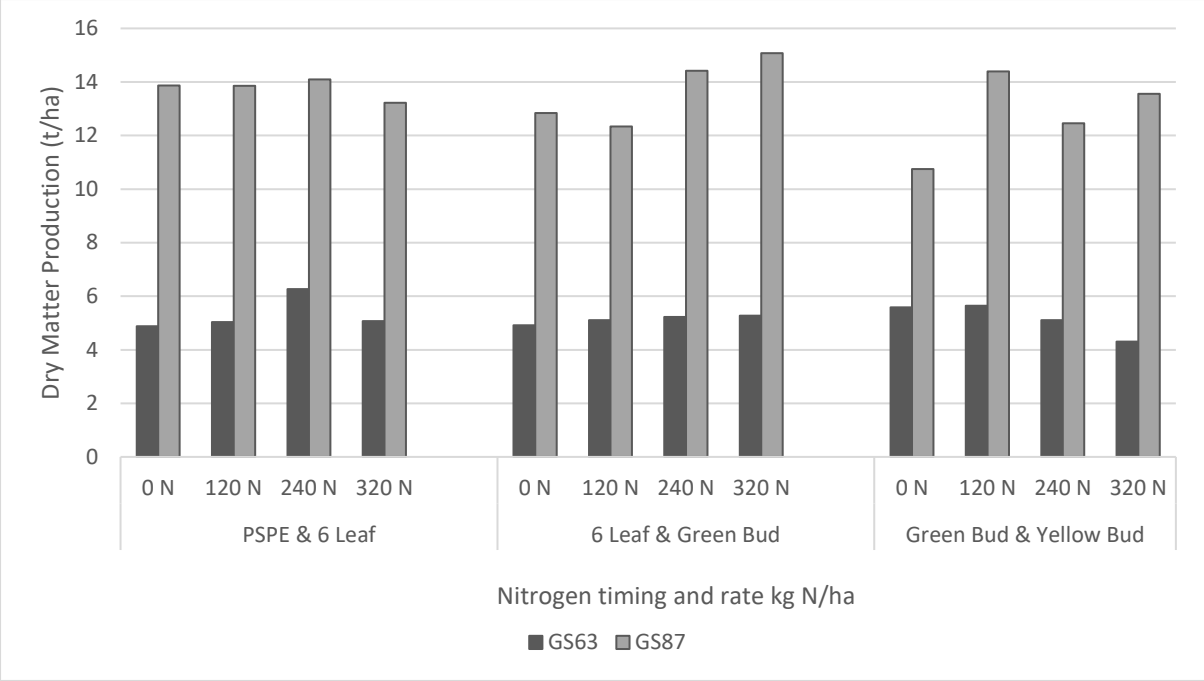


**Figure 2.** Influence of applied N fertiliser rate and timing on dry matter production at early flowering (GS63) and harvest – assessed 11-Aug and 4-Nov.



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## Trial 5 Influence of Fungicide Management Strategies on Blackleg and Sclerotinia Infection under Overhead Irrigation

**Project objective:** To determine the effectiveness of fungicide strategies for a susceptible canola cultivar grown under overhead irrigation

**Location:** Finley IRC **FAR Code:** C20-08-1

**Sown:** 28 April **Cultivar:** ATR Bonito

**Harvested:** 27th November 2020

**Rotation position:** Wheat (2019), Faba beans (2018), Fallow after rice (2017)

**Soil Management:** Wheat stubble incorporated with speed disc in Autumn

**Irrigation:** Overhead lateral irrigation 5 x 25mm in spring. Total applied 125mm

**GSR:** April-October 244mm. Total water available 369mm

Available Soil N: 129 kg N/ha (0 – 90cm)

**Key Messages:**

- *The trial grown under overhead irrigation was subject to branch infection of blackleg rather than crown stem canker infections (cv ATR Bonito).*
- *The most effective fungicide applications gave approximately 50-55% control of branch blackleg infection (incidence), with 20-30% flower sprays (applied for sclerotinia) giving 45-50% control of branch blackleg or upper canopy infection (UCI).*
- *No sclerotinia infection was identified in the trial.*
- *Despite visual observations indicating control of blackleg branch infection there were no significant yield responses in this trial to fungicide application (p=0.69).*
- *Control of phoma leaf spot on lower canopy leaves was recorded at approximately 45-60% when assessed at stem elongation and flowering.*

**Table 1.** Influence of fungicide strategy on canola seed yield (t/ha) grown under overhead irrigation.

| Treatment mL/ha | | | | Yield | |
|---|---|---|---|---|---|
| | At sowing | 4 – 6 leaf | 20-30% Flower main raceme | t/ha | |
| **1.** | Untreated | | | 3.59 | - |
| **2.** | ILeVO seed treatment 800 mL/100 kg of seed | ---- | ---- | 3.64 | - |
| **3.** | ILeVO & flutriafol (I.F) | ---- | ---- | 3.64 | - |
| **4.** | ILeVO (seed trt) | Prosaro 375mL/ha | ---- | 3.57 | - |
| **5.** | Flutriafol (I.F) | Miravis 450mL/ha | ---- | 3.72 | - |
| **6.** | ---- | Miravis 450mL/ha | ---- | 3.49 | - |
| **7.** | ---- | Prosaro 375mL/ha | ---- | 3.54 | - |
| **8.** | ---- | Miravis 450mL/ha | Prosaro 450mL/ha | 3.28 | - |
| **9.** | ---- | Prosaro 375mL/ha | Aviator 650mL/ha | 3.59 | - |
| **10.** | ---- | ---- | Prosaro 450mL/ha | 3.66 | - |
| **11.** | ---- | ---- | Aviator 650mL/ha | 3.69 | - |
| **12.** | ILeVO & flutriafol (I.F) | Prosaro 375mL/ha | Aviator 650mL/ha | 3.65 | - |
| **13.** | Flutriafol (I.F) | Miravis 450mL/ha | Prosaro 450mL/ha | 3.36 | - |
| | **Mean** | | | **3.57** | |
| | **LSD** | | | 0.43 | |
| | **P val** | | | 0.691 | |



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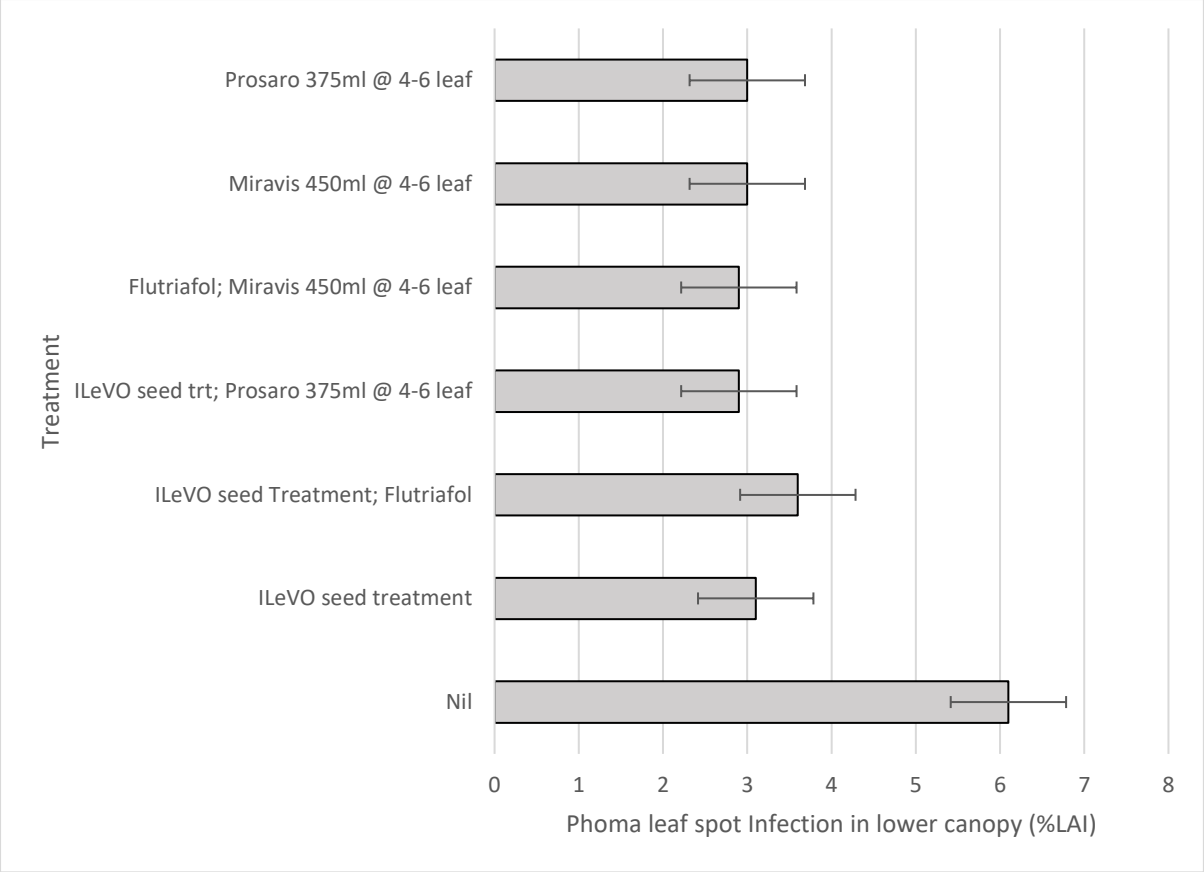


**Figure 1.** Influence of early season treatments on phoma leaf spot infection at stem elongation (GS50). P value <0.001.



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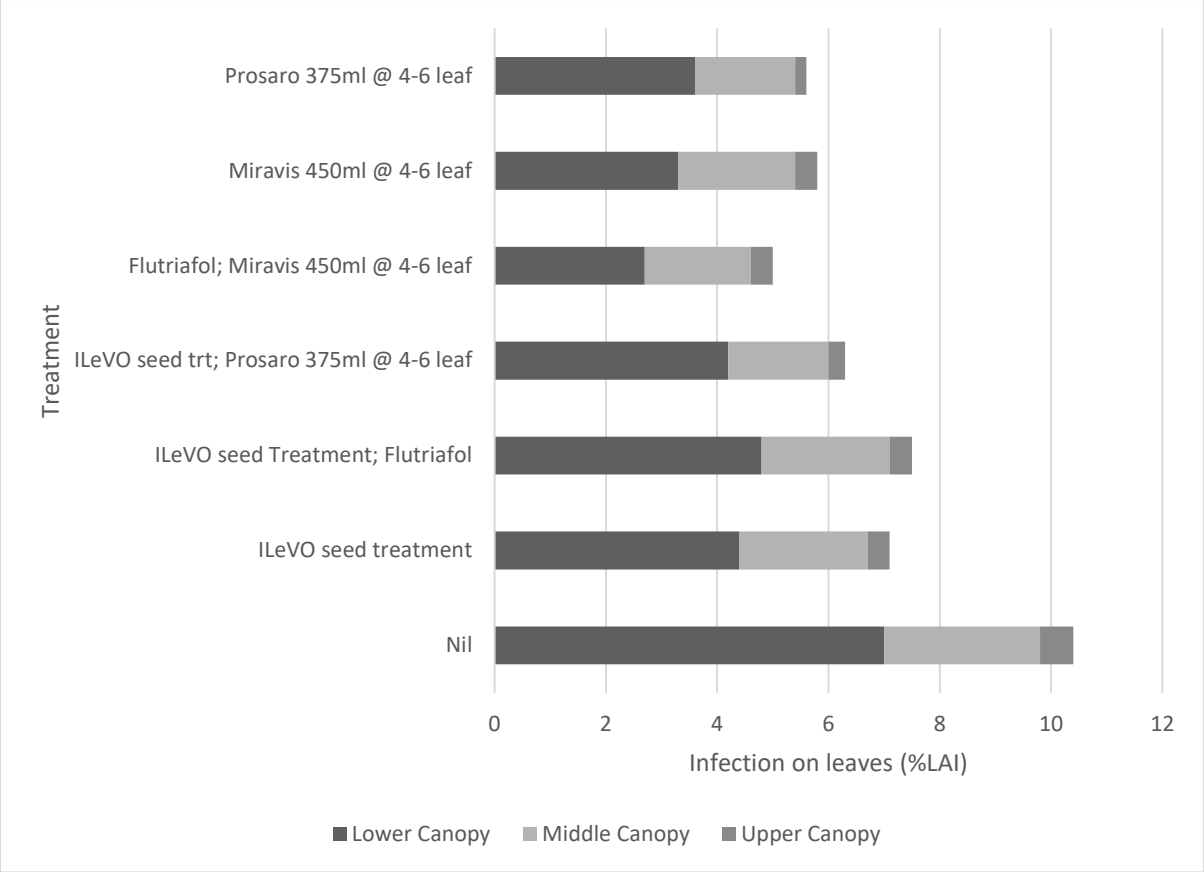


**Figure 2.** Influence of early season treatments on phoma leaf spot infection in the lower (LSD 1.67, P value 0.002), middle (ns, P value 0.231) and upper canopy (ns, P value 0.213) at flowering (GS67).

**Table 2.** Influence of different fungicide strategies on branch canker infection (% incidence) at harvest.

| **Treatment mL/ha** | | | | **Branch Canker** | |
|---|---|---|---|---|---|
| | **At sowing** | **4 – 6 leaf** | **20-30% Flower main raceme** | % | |
| **1.** | Untreated | | | 55 | a |
| **2.** | ILeVO seed treatment 800 mL/100 kg of seed | ---- | ---- | 32.5 | bc |
| **3.** | ILeVO & flutriafol (I.F) | ---- | ---- | 36.3 | bc |
| **4.** | ILeVO (seed trt) | Prosaro 375mL/ha | ---- | 46.3 | ab |
| **5.** | Flutriafol (I.F) | Miravis 450mL/ha | ---- | 32.5 | bc |
| **6.** | ---- | Miravis 450mL/ha | ---- | 25 | c |
| **7.** | ---- | Prosaro 375mL/ha | ---- | 45 | ab |
| **8.** | ---- | Miravis 450mL/ha | Prosaro 450mL/ha | 35 | bc |
| **9.** | ---- | Prosaro 375mL/ha | Aviator 650mL/ha | 26.3 | c |
| **10.** | ---- | ---- | Prosaro 450mL/ha | 30 | c |
| **11.** | ---- | ---- | Aviator 650mL/ha | 27.5 | c |
| **12.** | ILeVO & flutriafol (I.F) | Prosaro 375mL/ha | Aviator 650mL/ha | 37.5 | bc |
| **13.** | Flutriafol (I.F) | Miravis 450mL/ha | Prosaro 450mL/ha | 25 | c |
| | **Mean** | | | 34.9 | |
| | **LSD** | | | 14.17 | |
| | **P val** | | | 0.002 | |

Released:24 February 2021

## Trial 6 Influence of Plant Growth Regulation on Canola Yield and Profitability under Irrigation

**Project objective:** To examine whether experimental PGR (not commercially approved) application has any yield benefit in irrigated canola at different plant populations

**Location:** Finley IRC
**FAR Code:** C20-09-1
**Sown:** 28 April
**Cultivar:** HyTTec® Trophy
**Harvested:** 27th November 2020
**Rotation position:** Wheat (2019), Faba beans (2018), Fallow after rice (2017)
**Soil Management:** Wheat stubble incorporated with speed disc in Autumn
**Irrigation:** Overhead lateral irrigation 5 x 25mm in spring. Total applied 125mm
**GSR:** April-October 244mm. Total water available 369mm
Available Soil N: 129 kg N/ha (0 – 90cm)

**Key Messages:**

- *Experimental PGR management (based on gibberellin inhibitors) in irrigated canola resulted in significant differences in crop canopy height but no significant effect on seed yield irrespective of plant population.*
- *Reducing plant population did significantly reduce crop height at green bud (GS 51) and yellow bud (GS 59), however there was no difference in crop height at mid pod or harvest due to plant population.*
- *The highest population (48 plants/m$^2$ - 100seeds/m$^2$) of the TT hybrid produced significantly higher yields than lower plant populations based 38plants/m$^2$ - 60seeds/m$^2$ and 11 plants/m$^2$-20 seeds/m$^2$*
- *There was no benefit in harvested seed yield although the canopy was more suitable for direct heading due to its shorter stature at harvest*

**Table 1.** Influence of PGR application and different plant populations on the seed yield (t/ha) of HyTTec® Trophy.

| | Seed Rate & Plant population | | |
|---|---|---|---|
| | 20 seeds/m$^2$ | 60 seeds/m$^2$ | 100 seeds/m$^2$ |
| | **11 Plants/m2** | **38 Plants/m2** | **48 Plants/m2** |
| | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** |
| Untreated | 3.18 - | 3.86 - | 4.09 - |
| FAR PGR20/2 @ GB | 3.17 - | 3.84 - | 3.88 - |
| FAR PGR20/1 @ GB<br>FAR PGR20/2 @ YB | 3.15 - | 3.91 - | 4.23 - |
| | | | |
| **Mean** | **3.17 c** | **3.87 b** | **4.07 a** |
| | | | |
| **LSD Seed Rate p = 0.05** | 0.15 | **P val** | <0.001 |
| **LSD PGR Strategy p=0.05** | ns | **P val** | 0.399 |
| **LSD Seed Rate x PGR P=0.05** | ns | **P val** | 0.511 |

**Table 2.** Influence of PGR application (mean of three plant populations) on crop height (cm) assessed at GS59, GS75 and late seed fill – 10 Aug, 24 Sep & 12 Nov respectively, cv HyTTec® Trophy.

| | Crop Height (cm) | | |
|---|---|---|---|
| | **GS 59** | **GS 75** | **GS 86** |
| Untreated | 67.4 a | 154.3 a | 150.6 a |

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| | | | |
|---|---|---|---|
| FAR PGR20/2 @ GB | 55.2 c | 143.7 b | 141.8 b |
| FAR PGR20/1 @ GB<br>FAR PGR20/2 @ YB | 59.1 b | 136.9 c | 137.8 b |
| | | | |
| **LSD PGR Strategy p=0.05** | 2.3 | 5.4 | 4.7 |
| **P val** | <0.001 | <0.001 | 0.002 |

**Table 3.** Influence of plant population (mean of PGR treatments & untreated) on crop height (cm) assessed at GS59, GS75 and late seed fill – 10-Aug, 24-Sep, and 12-Nov respectively, cv HyTTec® Trophy.

| | Crop Height (cm) | | | |
|---|---|---|---|---|
| | **GS 51** | **GS 59** | **GS 75** | **GS 86** |
| 20 seeds/m2 | 15.5 b | 59.3 b | 154.5 - | 150.5 - |
| 60 seeds/m2 | 29.3 a | 72.3 a | 154.5 - | 149.5 - |
| 100 seeds/m2 | 30.8 a | 70.8 a | 153.8 - | 151.8 - |
| | | | | |
| **LSD Seed Rate** | 5.0 | 5.7 | ns | ns |
| **P val** | <0.001 | 0.003 | 0.857 | 0.781 |



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# Kerang VIC

*Irrigated trials conducted at the Kerang irrigated research centre 2020 were managed by the Irrigated Cropping Council*

## Trial 1 Optimum Plant Population Under Sprinkler Irrigation

**Project objective:** To compare identical plant population x cultivar canola trials under overhead and flood irrigation

**Location:** Kerang, Victoria
**Sown:** 23 April
**Harvested:** 18 November 2020
**FAR Code:** ICC C20-01-3
**Cultivar:** HyTTec® Trophy and 45Y28 RR
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Overhead sprinkler irrigation 4 applications totalling 108mm (1.08 ML/ha)
**GSR:** April-October 250mm. Total water available 358mm

***Key Messages:***

- *Establishment rate for the trial averaged 61%.*
- *Seeding population of the Roundup Ready variety 45Y28 RR made no difference to plant biomass by green bud stage. The low population of TT variety Hytec Trophy failed to 'catch up' to the higher population's biomass.*
- *Yield was maximised at the highest seeding rate (50 plants/m$^2$ - 80 seeds/m$^2$), but was not significantly different to that of the 40 and 60 seeds/m$^2$ treatments in both varieties.*
- *40 seeds/m$^2$ equates to a plant population of approximately 25 plants/m$^2$.*
- *Oil content was significantly different between varieties but not between seeding rates.*
- *While there was variation in the Harvest Index from 0.24 to 0.30, the differences were not statistically different for either seeding rate or variety.*
- *Water use efficiency was 15.8 kg/mm*

**Table 1.** Establishment - Plant population (plants/m$^2$) established from four seed rates with two different cultivars grown under overhead irrigation.

| | Established Population | | |
|---|---|---|---|
| **Seed Rate** | **HyTTec® Trophy** (Hybrid TT) | **45Y28 RR** (RR Y Series Hybrid) | **Mean** |
| | **Plants/m$^2$** | **Plants/m$^2$** | **Plants/m$^2$** |
| **20 seeds/m$^2$** | 12.0 c | 13.4 c | **12.7 d** |
| **40 seeds/m$^2$** | 19.7 c | 31.6 b | **25.7 c** |
| **60 seeds/m$^2$** | 30.9 b | 41.1 a | **36.0 b** |
| **80 seeds/m$^2$** | 42.5 a | 49.6 a | **46.1 a** |
| **Mean** | **26.3** | **33.9** | |
| | | | |
| **LSD Seed Rate p = 0.05** | 6.51 | **P val** | <0.001 |
| **LSD Cultivar p=0.05** | 4.60 | **P val** | 0.002 |
| **LSD Seed Rate x Cultivar.** | 9.20 | **P val** | 0.4103 |

*RR – Roundup Ready Hybrid*

**Table 2a.** Canopy measurements – dry matter (DM t/ha).



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| | Dry matter (t/ha) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Seeding Rate (seeds/m²)** | **20** | | **40** | | **60** | | **80** | |
| **Green Bud** | | | | | | | | |
| **TT** | 1.42 | d | 2.29 | cd | 2.46 | bcd | 2.49 | bcd |
| **RR** | 2.87 | abc | 3.78 | ab | 3.77 | ab | 4.17 | a |
| | $p_{var}$ = <0.001, p $_{rate}$ = 0.079, $p_{vxr}$ = 0.983, lsd $_{vxr}$ = 1.35, cv% = 31.5 | | | | | | | |
| **Early Flowering** | | | | | | | | |
| **TT** | 4.24 | b | 6.25 | a | 6.32 | a | 6.18 | a |
| **RR** | 6.14 | a | 7.54 | a | 7.52 | a | 6.23 | a |
| | $p_{var}$ = <0.001, p $_{rate}$ = 0.007, $p_{vxr}$ = 0.754, lsd $_{vxr}$ = 1.68, cv% = 17.3 | | | | | | | |
| **Harvest** | | | | | | | | |
| **TT** | 13.08 | b | 12.56 | b | 12.07 | b | 14.18 | ab |
| **RR** | 15.21 | ab | 13.97 | ab | 14.07 | ab | 16.42 | a |
| | $p_{var}$ = 0.018, p $_{rate}$ = 0.178, $p_{vxr}$ = 0.980, lsd $_{vxr}$ = 3.16, cv% = 15.4 | | | | | | | |

**Table 2b.** Canopy measurements – accumulated N (kg N/ha).

| | Accumulated N (kg N/ha) * | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Seeding Rate (seeds/m²)** | **20** | | **40** | | **60** | | **80** | |
| **Green Bud** | | | | | | | | |
| **TT** | 75.3 | c | 113.3 | bc | 124.8 | bc | 118.3 | bc |
| **RR** | 156.6 | a b | 202.6 | a | 201.7 | a | 208.2 | a |
| | $p_{var}$ = <0.001, p $_{rate}$ = 0.139, $p_{vxr}$ = 0.989, lsd $_{vxr}$ = 66.64, cv% = 30.2 | | | | | | | |
| **Early Flowering** | | | | | | | | |
| **TT** | 157.9 | b | 239.6 | a | 239.9 | a | 227.5 | a |
| **RR** | 229.4 | a | 226.1 | a | 265.1 | a | 252.5 | a |
| | $p_{var}$ = 0.075, p $_{rate}$ = 0.0.049, $p_{vxr}$ = 0.254, lsd $_{vxr}$ = 59.9, cv% = 17.7 | | | | | | | |
| **Harvest*** | | | | | | | | |
| **TT** | 233.5 | a | 195.0 | ab | 159.8 | b | 239.7 | a |
| **RR** | 194.5 | a b | 184.7 | ab | 157.2 | b | 200.7 | ab |
| | $p_{var}$ = 0.181, p $_{rate}$ = 0.059, $p_{vxr}$ = 0.800, lsd $_{vxr}$ = 68.4, cv% = 23.8 | | | | | | | |

*Accumulated N at harvest data should be viewed with caution as sampling errors resulted in variable nitrogen content depending on the proportion of grain in the sample tested.

The data presented in Tables 1a and 1b should be viewed with caution as there was variability in the data collected, as indicated by the high cv%.
Starting soil N was 215 kg N/ha (0-60cm). By early flowering, another 95 kg N/ha had been applied.



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Maximum biomass achieved at harvest was 16.4 t DM/ha by 45Y28 RR at the highest sowing rate, but this was not significantly different to any of the 45Y28 RR seeding rates or the highest rate of the TT variety.

Table 3. Yield and grain quality.

| **Seeding Rate (seeds/m$^2$)** | **20** | | **40** | | **60** | | **80** | |
|---|---|---|---|---|---|---|---|---|
| | | | | **Grain Yield (t/ha)** | | | | |
| **TT** | 3.25 | c | 3.79 | b | 3.79 | b | 4.08 | ab |
| **RR** | 3.80 | b | 4.02 | ab | 4.30 | a | 4.34 | a |
| | $p_{var}$ = 0.002, p $_{rate}$ = 0.002, $p_{vxr}$ = 0.624, lsd $_{vxr}$ = 0.47, cv% = 8.0 | | | | | | | |
| | | | | Oil content (%) | | | | |
| **TT** | 40.6 | b | 41.1 | b | 40.4 | b | 41.1 | b |
| **RR** | 44.7 | a | 44.2 | a | 44.1 | a | 44.1 | a |
| | $p_{var}$ = <0.001, p $_{rate}$ = 0.477, $p_{vxr}$ = 0.258, lsd $_{vxr}$ = 0.87, cv% = 1.4 | | | | | | | |
| | | | | Harvest Index | | | | |
| **TT** | 0.24 | | 0.30 | | 0.30 | | 0.28 | |
| **RR** | 0.24 | | 0.28 | | 0.29 | | 0.25 | |
| | $p_{var}$ = 0.447, p $_{rate}$ = 0.077, $p_{vxr}$ = 0.914, lsd $_{vxr}$ = NS, cv% = 16.9 | | | | | | | |

Highest yield grain was from the highest seeding rate (80 seeds/m$^2$) in both varieties. However the yields from the 40 and 60 seeds/m2 were statistically similar to that of the high seeding rate.

Oil content was only influenced by variety, not seeding rate.

While there were differences in the Harvest Index, these were not statistically significant.

The average yield for the trial was 3.92 t/ha. This represents a WUE of 15.8 kg/mm.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Trial 2 Optimum Plant Population Under Flood Irrigation

**Project objective:** To compare identical plant population x cultivar canola trials under overhead and flood irrigation.

**Location:** Kerang, Victoria
**Sown:** 23 April
**Harvested:** 18 November 2020
**FAR Code:** ICC C20-01-4
**Cultivar:** HyTTec® Trophy and 45Y28 RR
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Flood irrigation 3 applications totalling 300mm (3.0 ML/ha)
**GSR:** April-October 250mm. Total water available 550mm

***Key Messages:***

- *Establishment rate for the trial averaged 69%.*
- *There were differences in biomass at green bud, with the trend to lower biomass at lower seeding rates.*
- *There was no difference in biomass at early flowering or harvest from any of the treatments.*
- *Yield was not influenced by sowing rate in either variety.*
- *The lowest sowing rate of 20 seeds/m$^2$ equates to a plant population of approximately 14 plants/m$^2$.*
- *Oil content was significantly different between varieties but not between seeding rates.*
- *While there was variation in the Harvest Index from 0.18 to 0.25, the trend being to lower HI at the lower rates, and vice versa.*
- *Water use efficiency was 8.8 kg/mm*

**Table 1.** Establishment - Plant population (plants/m$^2$) established from four seed rates with two different cultivars grown under overhead irrigation.

| | Established Population | | |
|---|---|---|---|
| **Seed Rate** | **HyTTec® Trophy** (Hybrid TT) | **45Y28 RR** (RR Y Series Hybrid) | **Mean** |
| | **Plants/m$^2$** | **Plants/m$^2$** | **Plants/m$^2$** |
| **20 seeds/m$^2$** | 16.9 d | 17.6 d | **17.2 c** |
| **40 seeds/m$^2$** | 26.4 cd | 30.9 c | **28.7 b** |
| **60 seeds/m$^2$** | 35.1 bc | 35.9 bc | **35.5 b** |
| **80 seeds/m$^2$** | 44.6 ab | 46.8 a | **45.7 a** |
| **Mean** | | | |
| | | | |
| **LSD Seed Rate p = 0.05** | 7.46 | **P val** | <0.001 |
| **LSD Cultivar p=0.05** | NS | **P val** | 0.429 |
| **LSD Seed Rate x Cultivar.** | 10.55 | **P val** | 0.941 |

*RR – Roundup Ready Hybrid*



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 2a.** Canopy measurements – dry matter (DM t/ha).

| Dry matter (t/ha) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Seeding Rate (seeds/m²)** | 20 | | 40 | | 60 | | 80 | |
| **Green Bud** | | | | | | | | |
| **TT** | 2.43 | bc | 3.00 | bc | 3.88 | ab | 4.24 | a |
| **RR** | 2.98 | bc | 4.79 | a | 4.27 | a | 4.08 | a |
| | $p_{var}$ = 0.068, $p_{rate}$ = <0.001, $p_{vxr}$ = 0.387, lsd $_{vxr}$ = 0.954, cv% = 17.0 | | | | | | | |
| **Early Flowering** | | | | | | | | |
| **TT** | 6.38 | | 7.27 | | 8.61 | | 7.44 | |
| **RR** | 6.61 | | 7.76 | | 7.29 | | 8.55 | |
| | $p_{var}$ = 0.784, $p_{rate}$ = 0.103, $p_{vxr}$ = 0.306, lsd $_{vxr}$ = NS, cv% = 17.2 | | | | | | | |
| **Harvest** | | | | | | | | |
| **TT** | 16.85 | | 17.26 | | 16.14 | | 15.23 | |
| **RR** | 18.25 | | 16.56 | | 17.43 | | 15.59 | |
| | $p_{var}$ = 0.389, $p_{rate}$ = 0.177, $p_{vxr}$ = 0.665, lsd $_{vxr}$ = NS, cv% = 11.4 | | | | | | | |

**Table 2b.** Canopy measurements – accumulated N (kg N/ha).

| Accumulated N ((kg N/ha) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sowing Rate (seeds/m²)** | 20 | | 40 | | 60 | | 80 | |
| **Green Bud** | | | | | | | | |
| **TT** | 110.1 | c | 159.4 | abc | 184.8 | ab | 199.3 | a |
| **RR** | 134.6 | bc | 201.3 | a | 204.3 | a | 181.7 | ab |
| | $p_{var}$ = 0.068, $p_{rate}$ = <0.001, $p_{vxr}$ = 0.387, lsd $_{vxr}$ = 40.9, cv% = 16.2 | | | | | | | |
| **Early Flowering** | | | | | | | | |
| **TT** | 253 | | 236 | | 244 | | 239 | |
| **RR** | 202 | | 267 | | 236 | | 271 | |
| | $p_{var}$ = 0.964, $p_{rate}$ = 0.808, $p_{vxr}$ = 0.495, lsd $_{vxr}$ = NS, cv% = 25.1 | | | | | | | |
| **Harvest*** | | | | | | | | |
| **TT** | 298.8 | a | 267.6 | a | 216.7 | b | 257.2 | ab |
| **RR** | 231.9 | ab | 219.2 | b | 193.4 | b | 189.9 | b |
| | $p_{var}$ = 0.008, $p_{rate}$ = 0.125, $p_{vxr}$ = 0.795, lsd $_{vxr}$ = 73.7, cv% = 21.4 | | | | | | | |

*Accumulated N at harvest data should be viewed with caution as sampling errors resulted in variable nitrogen content depending on the proportion of grain in the sample tested.

The data presented in Tables 1a and 1b should be viewed with caution as there was variability in the data collected, as indicated by the high cv%.
Starting soil N was 158 kg N/ha (0-60cm). By early flowering, another 135 kg N/ha had been applied. There were differences in biomass measured at green bud, with the low seeding rate TT treatment having the lowest biomass, but not significantly different to either the low RR or 40 seeds/m² TT treatments.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

Maximum biomass achieved at harvest was 18.25 t DM/ha by 45Y28 RR at the lowest seeding rate, but this was not significantly different to that of any other treatment.

**Table 3**. Yield and grain quality.

| Grain Yield (t/ha) | | | | |
|---|---|---|---|---|
| **Sowing Rate (seeds/m$^2$)** | 20 | 40 | 60 | 80 |
| **TT** | 3.36 | 3.96 | 3.93 | 3.98 |
| **RR** | 3.65 | 4.07 | 4.01 | 4.10 |
| | $p_{var}$ = 0.340, p $_{rate}$ = 0.075, $p_{vxr}$ = 0.958, lsd $_{vxr}$ = NS, cv% = 11.3 | | | |
| **Oil content (%)** | | | | |
| **TT** | 42.5 b | 42.1 b | 42.4 b | 42.9 b |
| **RR** | 45.5 a | 45.3 a | 45.4 a | 45.3 a |
| | $p_{var}$ = <0.001, p $_{rate}$ = 0.243, $p_{vxr}$ = 0.218, lsd $_{vxr}$ = 0.64, cv% = 1.0 | | | |
| **Harvest Index** | | | | |
| **TT** | 0.18 c | 0.22 abc | 0.23 abc | 0.24 ab |
| **RR** | 0.19 bc | 0.23 abc | 0.22 abc | 0.25 a |
| | $p_{var}$ = 0.733, p $_{rate}$ = 0.023, $p_{vxr}$ = 0.883, lsd $_{vxr}$ = 0.053, cv% = 16.2 | | | |

Highest yield grain was from the highest rate (80 seeds/m$^2$) in both varieties. However the yields of all treatments were not statistically different i.e. variety or seeding rate did not affect yield.

Oil content was only influenced by variety, not sowing rate.

Harvest Index was influenced by sowing rate, with the high sowing rate of 80 seeds/m2 having the highest index of 0.25, although the results should be viewed with caution due to the high cv%.

The average yield for the trial was 3.88 t/ha. This represents a WUE of 8.8 kg/mm.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Trial 3 Nitrogen Use Efficiency Trial – Nitrogen Rates

**Project Objective:** To examine at the nitrogen use efficiency of canola grown under overhead irrigation

**Location:** Kerang, Victoria
**FAR Code:** ICC C20-03-2
**Sown:** 23 April
**Cultivar:** 45Y28 RR
**Harvested:** 18 November 2020
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Flood irrigation 3 applications totalling 300mm (3.0 ML/ha)
**GSR:** April-October 250mm. Total water available 550mm

***Key Messages:***

- *Relatively high starting N at sowing (158kg N/ha 0-60cm) saw little difference in the treatment canopies as measured by NDVI despite the wide range of N application rates.*
- *Plant biomass was similar across all treatments at early flowering, and had produced an average of 8.2 t DM/ha.*
- *Plant biomass at harvest averaged 13.8 t/ha across all treatments, with the highest N rates having the highest crop biomass.*
- *However, grain yield was not significantly different across all treatments excluding the '0 kg N/ha' treatment.*
- *While there was variation in the Harvest Index from 0.26 to 0.20, the differences were not statistically different.*
- *Allowing for soil N at sowing and starter N there was evidence of 60 kg N/ha mineralisation at this site.*

**Table 1.** Canopy measurements – NDVI, dry matter and accumulated plant N.

| **Treatments** | | | | | | |
|---|---|---|---|---|---|---|
| | 15 June | 15 July | Early Flowering | | Harvest* | |
| **Rate of Applied N** | NDVI | NDVI | DM (t/ha) | Accumulated N (kg N/ha) | DM (t/ha) | |
| **0 kg N/ha** | 0.70 | 0.85 | 7.64 | 250.9 | 11.19 | a |
| **80 kg N/ha** | 0.67 | 0.86 | 9.11 | 286.0 | 13.03 | ab |
| **120 kg N/ha** | 0.68 | 0.86 | 8.64 | 306.8 | 13.53 | ab |
| **160 kg N/ha** | 0.68 | 0.85 | 7.67 | 259.2 | 13.59 | ab |
| **200 kg N/ha** | 0.65 | 0.85 | 8.36 | 285.4 | 12.73 | ab |
| **240 kg N/ha** | 0.66 | 0.86 | 8.50 | 306.1 | 13.74 | ab |
| **280 kg N/ha** | 0.68 | 0.86 | 7.48 | 251.9 | 15.47 | bc |
| **320 kg N/ha** | 0.69 | 0.86 | 8.01 | 286.4 | 17.08 | c |
| **P val** | 0.773 | 0.042 | 0.352 | 0.592 | 0.013 | |
| **LSD** | NS | 0.006 | NS | NS | 2.82 | |
| **cv%** | 6.1 | 0.5 | 12.8 | 18.0 | 13.8 | |

* Accumulated N at harvest data is not presented as sampling errors resulted in variable data that averaged half that of the N accumulated at early flowering.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

Early season soil N was 158 kg N/ha (0-60cm) from cores taken 14 days after the trial was irrigated up. This appears to have been sufficient N to allow even canopy development until at least early flowering as indicated by the lack of difference in the NDVI measurements of the canopy, the biomass dry matter figures and the accumulated N. Although the '0 kg N/ha' treatment had the lowest early flowering biomass and accumulated N, neither were statistically different to the treatments where N was applied.
All treatments exceeded the 7 t DM/ha biomass target at early flowering, with a grand mean of 8.18 t/ha.
The '280 kg N/ha' and '320 kg N/ha' treatments were the only the only treatments to have higher biomass than that of the '0' treatment.

**Table 2**. Yield and grain quality.

| Treatment | Yield (t/ha) | Oil (%) | Test Weight (kg/hl) | Harvest Index |
|---|---|---|---|---|
| 0 kg N/ha | 3.00 a | 45.0 | 64.8 | 0.26 |
| 80 kg N/ha | 3.24 ab | 44.7 | 65.1 | 0.24 |
| 120 kg N/ha | 3.51 b | 45.0 | 64.5 | 0.24 |
| 160 kg N/ha | 3.49 b | 44.9 | 64.8 | 0.24 |
| 200 kg N/ha | 3.58 b | 44.6 | 64.4 | 0.26 |
| 240 kg N/ha | 3.57 b | 44.5 | 64.7 | 0.24 |
| 280 kg N/ha | 3.63 b | 44.5 | 64.0 | 0.23 |
| 320 kg N/ha | 3.63 b | 44.2 | 63.9 | 0.20 |
| **P val** | 0.038 | 0.003 | 0.172 | 0.400 |
| **LSD** | 0.397 | 7.783 | NS | NS |
| **cv%** | 7.8 | 6.3 | 1.0 | 15.9 |

Highest yield grain was from the two highest N rates, but these were not significantly different from the '80 kg N/ha' treatment yield.

Trial mean yield was 3.46 t/ha. WUE was 6.3 kg/mm.

While there were differences in the Harvest Index, these were not statistically significant.

Higher N application did not result in differences in grain quality.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Trial 4 Nitrogen Use Efficiency Trial – Nitrogen Timing Trial

**Project Objective:** To examine at the nitrogen use efficiency of canola grown under overhead irrigation

**Location:** Kerang, Victoria
**FAR Code:** ICC C20-04-2
**Sown:** 23 April
**Cultivar:** 45Y28 RR
**Harvested:** 18 November 2020
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium grey clay
**Irrigation:** Flood irrigation 3 applications totalling 300mm (3.0 ML/ha)
**GSR:** April-October 250mm. Total water available 550mm

***Key Messages:***

- *Accumulated N at early flowering was 190kg N/ha from the treatments with no applied N, which represented the amount of N supplied by the soil.*
- *The crop responded to increasing N rate and later application.*
- *Higher N rate produced a decrease in oil content.*
- *The mean Harvest Index was 0.27, with no statistical difference between treatments.*

**Table 1:** Treatment Summary – N application rates (kg N/ha) and timing (Growth Stage).

| **Treatments** | | | | | |
|---|---|---|---|---|---|
| **Intended N application** | Sowing | 6 leaf | Green Bud | Early Flower | |
| **Date** | 29 May | 8 September | 18 September | 4 October | Total N applied |
| **Treatment 1** | 0 | 0 | 0 | | 0 |
| **Treatment 2** | 40 | 40 | | | 80 |
| **Treatment 3** | 80 | 80 | | | 160 |
| **Treatment 4** | 120 | 120 | 0 | | 240 |
| **Treatment 5** | | 0 | 0 | | 0 |
| **Treatment 6** | | 40 | 40 | | 80 |
| **Treatment 7** | | 80 | 80 | | 160 |
| **Treatment 8** | | 120 | 120 | | 240 |
| **Treatment 9** | | | 0 | 0 | 0 |
| **Treatment 10** | | | 40 | 40 | 80 |
| **Treatment 11** | | | 80 | 80 | 160 |
| **Treatment 12** | | | 120 | 120 | 240 |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 2.** Canopy measurements – NDVI, dry matter and accumulated plant N.

| Treatments | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 15 June | 15 July | | Early Flowering | | | | Harvest* | |
| **Treatment** | | NDVI | NDVI | | DM (t/ha) | | Accumulated N (kg N/ha) | | DM (t/ha) | |
| 00-6l | 0 | 0.51 | 0.84 | ab | 7.52 | abc | 193.4 | d | 11.09 | |
| 00-6l | 80 | 0.47 | 0.84 | ab | 7.01 | abc | 238.9 | abcd | 12.28 | |
| 00-6l | 160 | 0.52 | 0.85 | a | 8.25 | a | 292.7 | a | 14.91 | |
| 00-6l | 240 | 0.50 | 0.85 | a | 8.03 | a | 291.8 | a | 14.25 | |
| 6l-GB | 0 | 0.43 | 0.82 | b | 7.14 | abc | 225.1 | abcd | 9.92 | |
| 6l-GB | 80 | 0.49 | 0.82 | b | 6.63 | c | 216.2 | bcd | 15.05 | |
| 6l-GB | 160 | 0.45 | 0.83 | ab | 7.25 | abc | 267.6 | abc | 12.35 | |
| 6l-GB | 240 | 0.48 | 0.83 | ab | 6.88 | abc | 281.3 | ab | 14.57 | |
| GB-EF | 0 | 0.45 | 0.83 | ab | 6.43 | c | 212.6 | cd | 11.41 | |
| GB-EF | 80 | 0.46 | 0.83 | ab | 7.17 | abc | 200.5 | cd | 12.53 | |
| GB-EF | 160 | 0.47 | 0.84 | ab | 6.57 | bc | 226.0 | abcd | 14.27 | |
| GB-EF | 240 | 0.46 | 0.84 | ab | 6.78 | abc | 204.5 | cd | 14.12 | |
| | **p timing** | 0.110 | 0.004 | | 0.042 | | 0.033 | | ^ | |
| | **p N rate** | 0.869 | 0.582 | | 0.770 | | 0.019 | | | |
| | **lsd txr** | NS | 0.023 | | 1.54 | | 69.14 | | | |
| | **cv%** | 12.0 | 2.0 | | 15.0 | | 20.20 | | 11.5 | |

* Accumulated N at harvest data is not presented as sampling errors resulted in variable data that averaged half that of the N accumulated at early flowering.
^ There was significant interaction between timing and rate $p_{txr} = 0.026$

There was some variation in the data from the initial NDVI assessment taken on June 15, probably due to slightly uneven establishment. By July 15, the analysis of the NDVI readings suggested some treatment differences but it would be difficult to attribute these to the treatments given the relatively low range of treatment means and the use of a hand held greenseeker to obtain the data.

Accumulated N at early flowering saw the average for the '0 kg N/ha' treatments being 210 kg N/ha. After subtracting the starter N, this leaves approximately 190 kg N/ha being supplied by the soil.

The trend in biomass at early flowering was for greater biomass where N had been applied earlier and at a greater rate. The trial mean for biomass at early flowering was 7.1 t/ha.
Final biomass at harvest had interaction between the treatments ($p_{txr} = 0.026$) and so only the treatment means are presented. As a general observation, the higher the N rate, the more biomass, with little difference between the timings.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 3a**. Influence of N timing on yield and grain quality.

| Timing | Grain Yield (t/ha) | | Oil (%) | Test Weight (kg/hl) | Harvest Index |
|---|---|---|---|---|---|
| **Sowing/6 leaf** | 3.47 | c | 45.8 | 63.4 | 0.25 |
| **6 leaf/Green Bud** | 3.73 | b | 45.9 | 64.5 | 0.27 |
| **Green Bud/Early Flower** | 4.02 | a | 45.9 | 64.3 | 0.29 |
| **P val** | <0.001 | | 0.687 | 0.136 | 0.087 |
| **LSD** | 0.238 | | NS | NS | NS |
| **cv%** | 8.8 | | 1.3 | 1.3 | 16.3 |

Analysis of the yield data focussing on the timing of N application shows a positive response to later N application, with no response in oil content, test weight or harvest index.

**Table 3b**. Influence of N rate on yield and grain quality.

| N rate (kg N/ha) | Grain Yield (t/ha) | | Oil (%) | | Test Weight (kg/hl) | Harvest Index |
|---|---|---|---|---|---|---|
| **0** | 3.39 | b | 46.7 | a | 64.2 | 0.29 |
| **80** | 3.57 | b | 46.0 | b | 64.1 | 0.25 |
| **160** | 3.99 | a | 45.5 | c | 64.0 | 0.27 |
| **240** | 4.02 | a | 45.1 | c | 64.6 | 0.27 |
| **P val** | <0.001 | | <0.001 | | 0.283 | 0.305 |
| **LSD** | 0.274 | | 0.491 | | NS | NS |
| **cv%** | 8.8 | | 1.3 | | 1.3 | 16.3 |

Analysis of the yield data focussing on the rate of N application shows a positive response to the 160 kg N/ha rate, with no further increase at 240 kg N/ha. Higher rate of N application was a negative response in oil content, with no response in test weight or harvest index.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 4**. Rate by Timing results for grain yield and oil content.

| **Yield (t/ha)** | | | | |
|---|---|---|---|---|
| | 0 kg N/ha | 80 kg N/ha | 160 kg N/ha | 240 kg N/ha |
| **Sowing/6 leaf** | 3.41 e | 3.37 e | 3.53 de | 3.56 de |
| **6 leaf/Green Bud** | 3.23 e | 3.64 de | 3.95 bcd | 4.12 abc |
| **Green Bud/Early Flower** | 3.52 de | 3.70 cde | 4.49 a | 4.37 ab |
| **$p_{timing}$ = <0.001, $p_{rate}$ = <0.001, $p_{txr}$ = 0.117, $lsd_{txr}$ = 0.475, cv% = 8.8** | | | | |
| Oil (%) | | | | |
| | 0 kg N/ha | 80 kg N/ha | 160 kg N/ha | 240 kg N/ha |
| **Sowing/6 leaf** | 46.7 a | 45.9 bc | 45.2 de | 45.2 de |
| **6 leaf/Green Bud** | 46.7 ab | 46.1 abc | 45.6 cde | 45.3 de |
| **Green Bud/Early Flower** | 46.8 a | 46.3 abc | 45.8 cd | 44.8 e |
| $p_{timing}$ = 0.687, $p_{rate}$ = <0.001, $p_{txr}$ = <0.001, $lsd_{txr}$ = 0.850, cv% = 1.3 | | | | |

Highest yield was 4.49 t/ha where 160 kg N/ha was split between green bud and early flowering application. This treatment was not significantly different to the 240 kg N/ha applied at either the same stages or the 6 leaf/green bud treatments.

While there was a range of 0.22 to 0.30 in the Harvest Index, there were no statistical differences and the trial mean was 0.27.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

Optimising Irrigated Grains

# Optimising Irrigated Grains (FAR1906-003RTX)

**A Grains Research & Development Corporation (GRDC) investment**

## PROVISIONAL HARVEST RESULTS:

# Irrigated Winter and Spring Barley Trials

Released:24 February 2021

The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

# Finley Irrigated Research Centre NSW

*Irrigated trials conducted at the Finley irrigated research centre 2020 were managed by FAR Australia, hosted by Southern Growers.*

## Trial 1 Nitrogen Use Efficiency Trial – Nitrogen Rates

**Protocol Objective:**
To evaluate nitrogen use efficiency in winter barley under different rates of applied N fertiliser applied as pre drill urea (46% N) grown under overhead irrigation (travelling lateral).

**Location:** Finley IRC
**FAR Code:** FAR B20-03-1
**Sown:** 24 April
**Cultivar:** Cassiopee
**Harvested:** 28th November 2020
**Rotation position:** Fallow (2019), Faba bean (2018), Wheat (2017)
**Soil Management:** Cultivated with speed disc in Autumn
**Irrigation:** Overhead lateral irrigation 5 x 25mm in spring. Total applied 125mm (1.25 ML/ha)
**GSR:** April-October 244mm. Total water available 369mm

**Key Points:**

*Winter barley germplasm cv Cassiopee following fallow with an estimated 226 kg N/ha available soil mineral N (0-90cm) gave no response to applied nitrogen fertiliser (Urea 46% N).*

- *There was no significant difference in yield due to nitrogen rate (0-320kg N/ha), with a trend suggesting declining yield as more N was applied that was linked to earlier lodging.*
- *The longer season and later flowering of Cassiopee and crop lodging were also contributory factors to lower grain yields and harvest indices.*
- *High inherent soil fertility resulted combined with 24 April sowing produced high dry matter at harvest but very poor harvest indices, ranging from 24.2% to 29.4%.*
- *The longer season and later flowering of Cassiopee and crop lodging were also contributory factors to lower grain yields and harvest indices.*
- *Protein was very high and significantly increased as more nitrogen fertiliser was applied, up to 200kg N/ha.*
- *There was no clear trend or significant difference in total dry matter assessed at harvest due to nitrogen rate with an average dry matter production of 20t/ha (range 19 – 21.5t/ha).*
- *Nitrogen offtake in the crop canopy at harvest (grain & straw) ranged from 232 - 333kg N/ha with the lower figure recoded in the zero 0 plots. Differences were not significant (p=0.059)*
- *N offtake in the crop canopy peaked at 333kg N/ha when 120kg N/ha was applied.*

Winter barley yields produced relatively modest grain yields (5.73 – 6.52t/ha) in this first cereal situation following fallow (Table 1) with no yield response to applied nitrogen fertiliser (urea 46% N).



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 1**. Influence of applied nitrogen (N) rate on grain yield (t/ha) and % protein when fertiliser was applied at GS30 and GS32.

| Nitrogen Treatment Rate & Timing | | Total Nitrogen | Grain yield and quality | |
|---|---|---|---|---|
| | | | Yield | Protein |
| | | N/ha | t/ha | % |
| **1.** | 0kg N/ha | 0 | 6.52 - | 16.2 d |
| **2.** | 40kg N/ha@GS30 & 40kg N/ha@GS32 | 80 | 6.09 - | 17.2 cd |
| **3.** | 60kg N/ha@ GS30 & 60kg N/ha@ GS32 | 120 | 6.24 - | 17 d |
| **4.** | 80kg N/ha@ GS30 & 80kg N/ha@ GS32 | 160 | 5.95 - | 17.3 bcd |
| **5.** | 100kg N/ha@ GS30 & 100kg N/ha@ GS32 | 200 | 6.02 - | 18.2 abc |
| **6.** | 120kg N/ha@ GS30 & 120kg N/ha@ GS32 | 240 | 5.73 - | 18.5 ab |
| **7.** | 140kg N/ha@ GS30 & 140kg N/ha@ GS32 | 280 | 5.84 - | 18.7 a |
| **8.** | 160kg N/ha@ GS30 & 160kg N/ha@ GS32 | 320 | 5.76 - | 19.1 a |
| | **Mean** | | 6.01 | 17.76 |
| | **LSD** | | ns | 1.18 |
| | **P val** | | 0.138 | <0.001 |

Lower grain yields were in contrast to high final harvest dry matter (grain and straw combined) at harvest which averaged approximately 20t/ha, an indication of a poor ability to convert dry matter produced into grain (Table 2). High dry matter production combined with later flowering (compared to RGT Planet spring barley) and lodging reduced the yield of the winter barley in this trial relative to spring barley grown in the same trials.

**Table 2.** Influence of applied nitrogen (N) rate on total dry matter (grain and straw) (t/ha) and nitrogen offtake (kg N/ha) at harvest when fertiliser was applied at GS30 and GS32.

| Nitrogen Treatment Rate & Timing | | Total Nitrogen | Dry matter | N offtake |
|---|---|---|---|---|
| | | N/ha | t/ha | Kg/ha |
| **1.** | 0kg N/ha | 0 | 19.87 - | 232 - |
| **2.** | 40kg N/ha@GS30 & 40kg N/ha@GS32 | 80 | 19.00 - | 235 - |
| **3.** | 60kg N/ha@ GS30 & 60kg N/ha@ GS32 | 120 | 19.94 - | 333 - |
| **4.** | 80kg N/ha@ GS30 & 80kg N/ha@ GS32 | 160 | 21.51 - | 266 - |
| **5.** | 100kg N/ha@ GS30 & 100kg N/ha@ GS32 | 200 | 19.41 - | 317 - |
| **6.** | 120kg N/ha@ GS30 & 120kg N/ha@ GS32 | 240 | 18.83 - | 253 - |
| **7.** | 140kg N/ha@ GS30 & 140kg N/ha@ GS32 | 280 | 21.23 - | 265 - |
| **8.** | 160kg N/ha@ GS30 & 160kg N/ha@ GS32 | 320 | 19.94 - | 279 - |
| | **Mean** | | **19.97** | **273** |
| | **LSD** | | ns | 69 |
| | **P val** | | 0.64 | 0.0592 |

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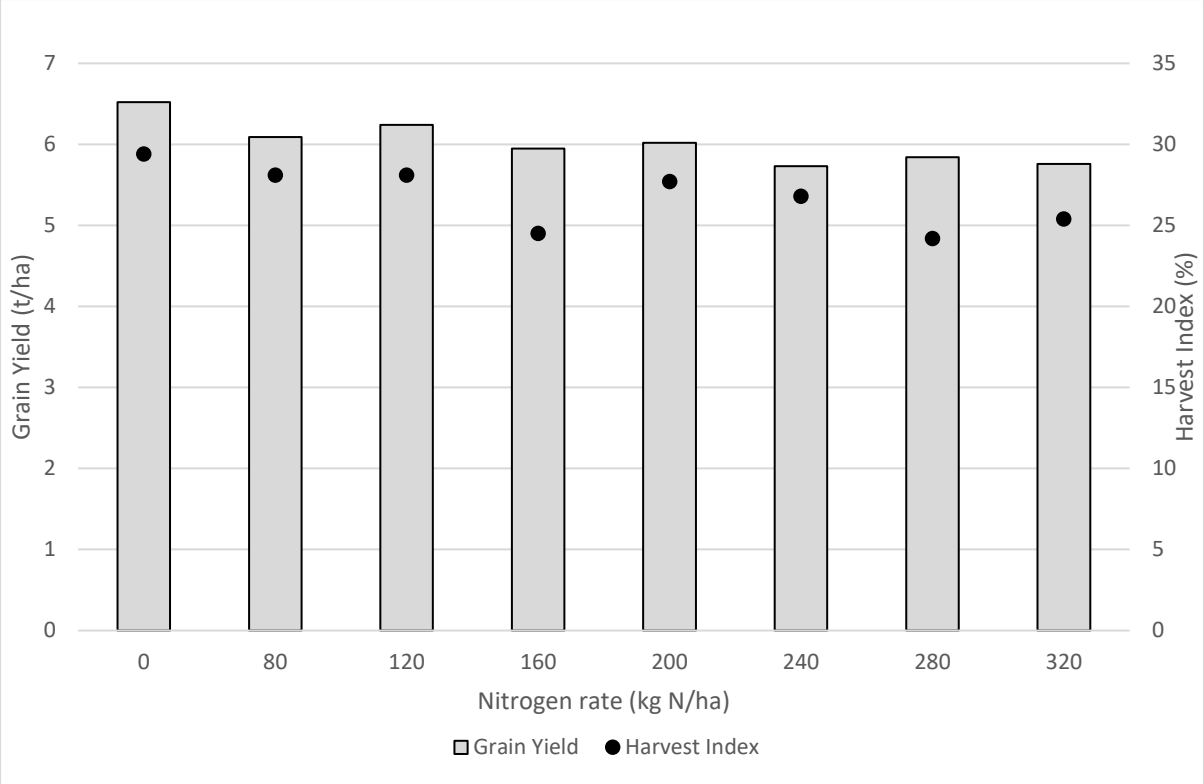


**Figure 1.** Grain yield and harvest index when varying nitrogen rate.

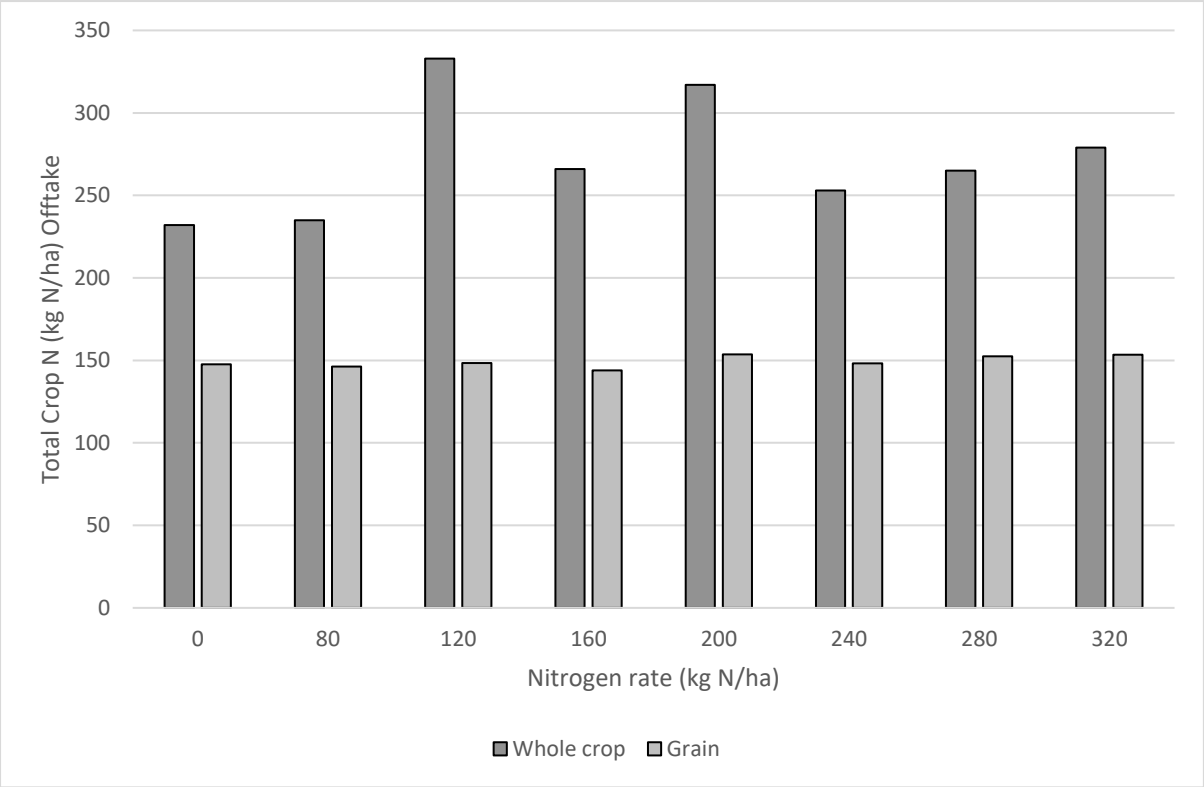


**Figure 2.** Nitrogen offtake when varying nitrogen rate.

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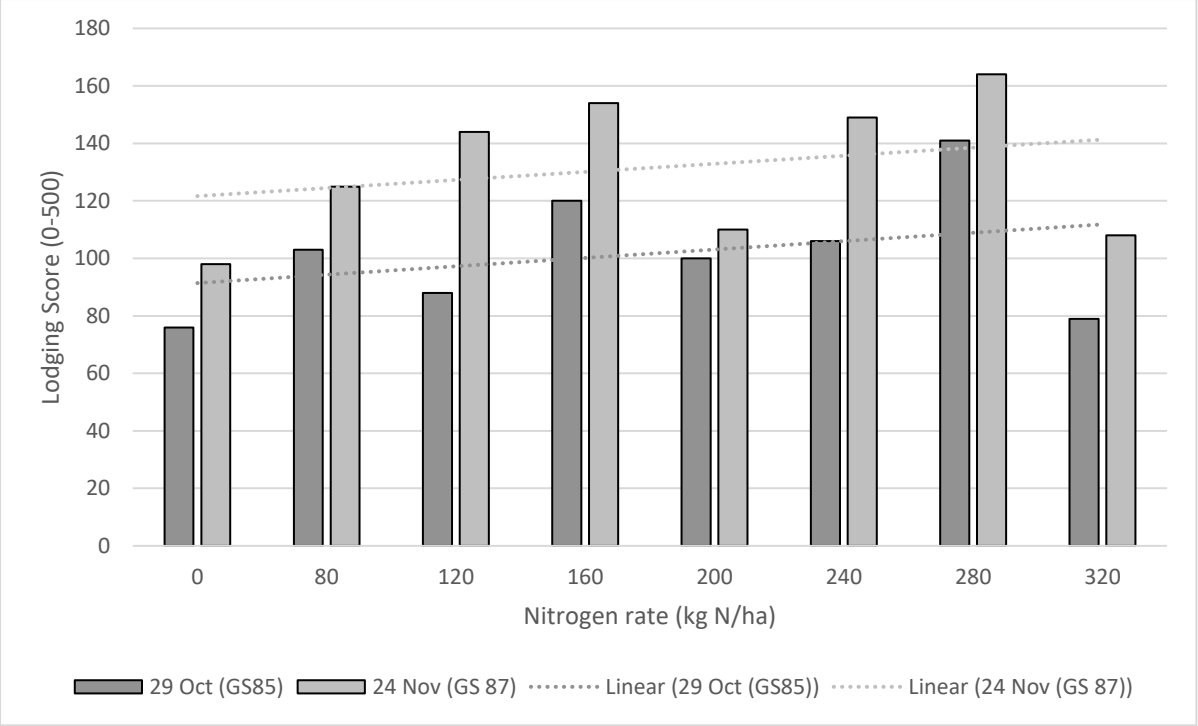


**Figure 32.** Lodging score (lodging index 0 – 500) when varying nitrogen rates from 0 – 320kg N/ha.



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## Trial 2 Nitrogen Use Efficiency Trial – Nitrogen Timing Trial

**Protocol Objective:**

To evaluate nitrogen use efficiency in winter barley under different rates and timings of applied N fertiliser applied as pre drill urea (46% N) grown under overhead irrigation (travelling lateral).

**Location:** Finley IRC
**FAR Code:** FAR B20-04-1
**Sown:** 24 April
**Cultivar:** Cassiopee
**Harvested:** 28th November 2020
**Rotation position:** Fallow (2019), Faba bean (2018), Wheat (2017)
**Soil Management:** Cultivated with speed disc in Autumn
**Irrigation:** Overhead lateral irrigation 5 x 25mm in spring. Total applied 125mm (1.25 ML/ha)
**GSR:** April-October 244mm. Total water available 369mm

**Key Points:**

- *With high soil fertility following fallow (226 kg N/ha available mineral N (0-60cm)) there was no significant difference in grain yield N timing (at N rates between 80 – 240kg N/ha).*
- *There was a trend for grain yields to decline with higher rates of applied N ; with a significant reduction in yield at the highest rate of N applied (240kg N/ha)..*
- *Grain proteins were very high in all treatments and increased as higher rates of N were applied, but significantly where the N timing split was early (sowing/ tillering (GS23)) there was no effect of N rate on protein.*
- *With the later N timing split (pseudo stem erect/third node (GS30-33)) higher rates of N were noted to significantly increase grain protein.*
- *There was a significant interaction between nitrogen rate and timing on grain protein; higher protein was achieved with higher rates of nitrogen at the later timings, compared to the early timing application where N rate had no impact on grain protein.*
- *Nitrogen rate or timing had no significant impact on harvest dry matter with an average of just over 20t/ha in the trial.*
- *N offtake in the grain and straw indicated more N recovery in the N timing applied at tillering/pseudo stem erect (GS23/GS30) although this produced no significant difference in yield, grain protein or dry matter production.*

Winter barley grain yields ranged from 6.14 – 6.79t/ha and were significantly higher when less nitrogen was applied (Table 1) with 0 and 80kg N/ha being significantly higher yielding than 240kg N/ha.



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**Table 1.** Influence of different split N application timings (50:50 splits) and N rates on grain yield (t/ha).

| | Nitrogen Application Rate | | | |
|---|---|---|---|---|
| | **0kg N/ha** | **80kg N/ha** | **160kg N/ha** | **240kg N/ha** |
| | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** |
| **Sowing & GS23** | 6.79 - | 6.65 - | 6.29 - | 6.16 - |
| **GS23 & GS30** | 6.59 - | 6.44 - | 6.46 - | 6.27 - |
| **GS30 & GS33** | 6.45 - | 6.58 - | 6.38 - | 6.14 - |
| **Mean** | **6.61 a** | **6.56 a** | **6.38 ab** | **6.19 b** |
| | | | | |
| **LSD N Application Timing p = 0.05** | | ns | **P val** | 0.778 |
| **LSD N Application Rate p=0.05** | | 0.23 | **P val** | 0.004 |
| **LSD N Timing. x N Rate. P=0.05** | | ns | **P val** | 0.587 |

Grain proteins were very high (15-18.3%) and there was a significant interaction between applied N rate and timing (p=0.016) that suggested that N rate had no effect on grain protein when fertiliser application was made early but had a significant effect when N timings were made later (Table 2).

**Table 2.** Protein (%) of nitrogen application rates split equally at three different application timings.

| | Nitrogen Application Rate | | | |
|---|---|---|---|---|
| | **0kg N/ha** | **80kg N/ha** | **160kg N/ha** | **240kg N/ha** |
| | **Protein (%)** | **Protein (%)** | **Protein (%)** | **Protein (%)** |
| **Sowing & GS23** | 16.5 de | 17.2 cd | 17.3 bcd | 17.2 cd |
| **GS23 & GS30** | 15.8 ef | 17.3 cd | 18.0 abc | 18.3 ab |
| **GS30 & GS33** | 15.3 f | 16.7 de | 18.0 abc | 18.3 a |
| **Mean** | **15.8 c** | **17.1 b** | **17.8 a** | **17.9 a** |
| | | | | |
| **LSD N Application Timing p = 0.05** | | ns | **P val** | 0.563 |
| **LSD N Application Rate p=0.05** | | 0.56 | **P val** | <0.001 |
| **LSD N Timing. x N Rate. P=0.05** | | 0.96 | **P val** | 0.039 |

*Protein figures followed by different letters are considered to be statistically different (p=0.05)*

Dry matter production at harvest averaged 20.34t/ha but there was no significant differences due to timing or N rate, indicating that at higher rates of applied N fertiliser harvest indices were reduced (a smaller proportion of the dry matter produced was turned in grain) (Table 3.) Nitrogen offtake in the crop canopy as a whole was significantly higher when N application was timed at GS23 and GS30 (Table 4).



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 3.** Harvest dry matter (t/ha) of nitrogen application rates split equally at three different application timings.

| | Nitrogen Application Rate | | | |
|---|---|---|---|---|
| | **0kg N/ha** | **80kgN/ha** | **160kg N/ha** | **240kg N/ha** |
| | **DM t/ha** | **DM t/ha** | **DM t/ha** | **DM t/ha** |
| **Sowing & GS23** | 20.72 - | 18.59 - | 20.58 - | 21.75 - |
| **GS23 & GS30** | 20.2 - | 21.17 - | 20.65 - | 19.77 - |
| **GS30 & GS33** | 21.52 - | 20.06 - | 18.49 - | 20.58 - |
| **Mean** | **20.81 -** | **19.94 -** | **19.90 -** | **20.70 -** |
| | | | | |
| **LSD N Application Timing p = 0.05** | | ns | **P val** | 0.958 |
| **LSD N Application Rate p=0.05** | | ns | **P val** | 0.543 |
| **LSD N Timing. x N Rate. P=0.05** | | ns | **P val** | 0.197 |

*DM figures followed by different letters are considered to be statistically different (p=0.05)*

**Table 4.** Nitrogen offtake (kg/ha) of nitrogen application rates split equally at three different application timings.

| | Nitrogen Application Rate | | | | |
|---|---|---|---|---|---|
| | **0kg/ha N** | **80kg/ha N** | **160kg/ha N** | **240kg/ha N** | **Mean** |
| | **N offtake kg/ha** | **N offtake kg/ha** | **N offtake kg/ha** | **N offtake kg/ha** | **N offtake kg/ha** |
| **Sowing & GS23** | 221 - | 277 - | 269 - | 240 - | **252 b** |
| **GS23 & GS30** | 305 - | 376 - | 311 - | 387 - | **345 a** |
| **GS30 & GS33** | 255 - | 213 - | 271 - | 305 - | **261 b** |
| | | | | | |
| **Mean** | **260 -** | **289 -** | **284 -** | **311 -** | |
| | | | | | |
| **LSD N Application Timing p = 0.05** | | 50 | **P val** | | 0.007 |
| **LSD N Application Rate p=0.05** | | ns | **P val** | | 0.113 |
| **LSD N Timing. x N Rate. P=0.05** | | 71 | **P val** | | 0.070 |

*Nitrogen offtake figures followed by different letters are considered to be statistically different (p=0.05)*



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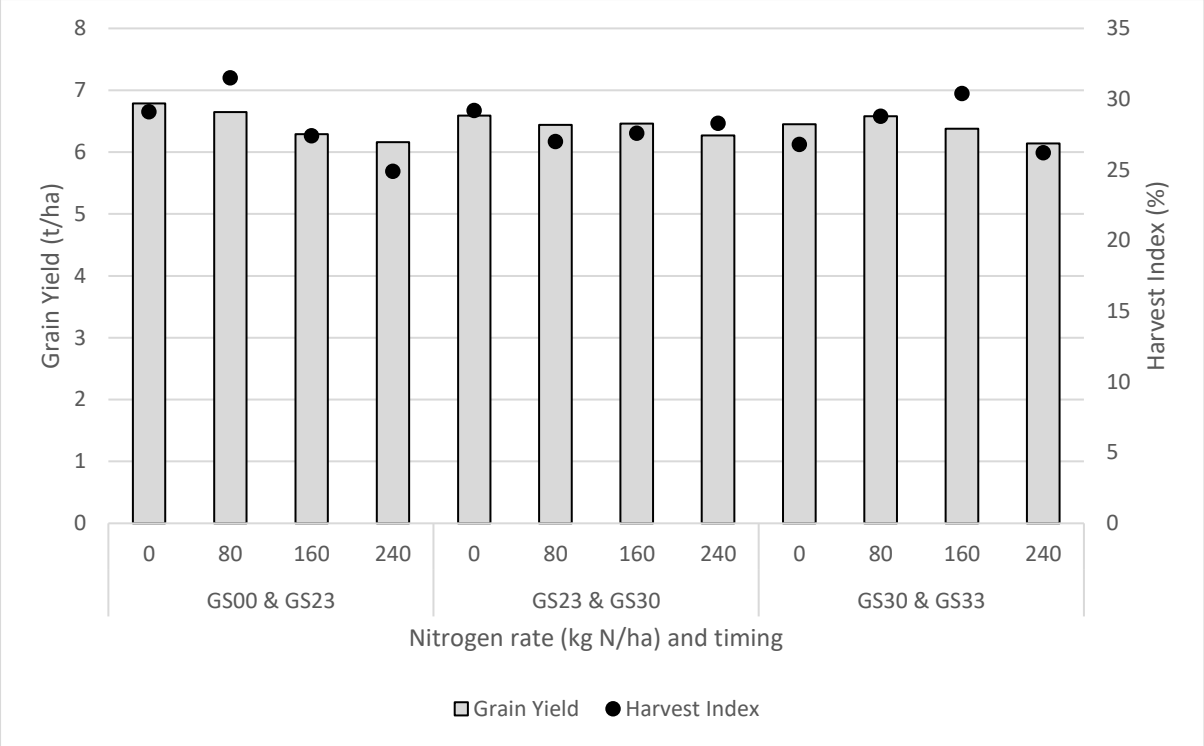


**Figure 1.** Grain yield and harvest index.

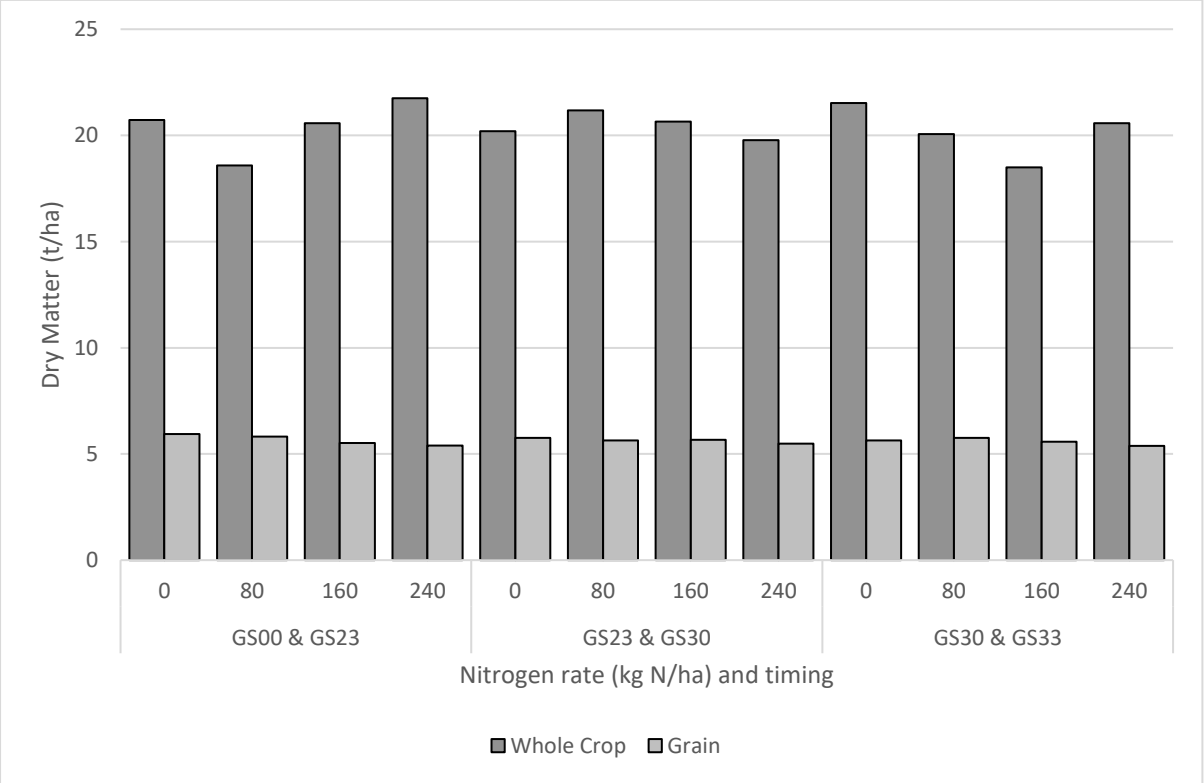


**Figure 2.** Dry matter offtake when varying nitrogen rate and timing.

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## Trial 3 Lodging Control in Irrigated Crops – Winter and Spring Barley

**Protocol Objective:**
To compare and contrast plant growth regulation strategies in winter and spring barley germplasm.

**Location:** Finley IRC
**FAR Code:** FAR B20-09-1
**Sown:** 24 April
**Cultivar:** RGT Planet & Cassiopee
**Harvested:** 28th November 2020
**Rotation position:** Fallow (2019), Faba bean (2018), Wheat (2017)
**Soil Management:** Cultivated with speed disc in Autumn
**Irrigation:** Overhead lateral irrigation 5 x 25mm in spring. Total applied 125mm (1.25 ML/ha)
**GSR:** April-October 244mm. Total water available 369mm

**Key Pointss:**

- *Under overhead irrigation in a fertile rotation position (first barley after fallow) the spring barley RGT Planet (7.27t/ha) significantly out yielded the winter cultivar Cassiopee (6.13t/ha).*
- *Cassiopee was subject to significantly more lodging and showed responses to PGR applications of Moddus Evo in terms of reduced crop height, lodging control and yield (although yield effects of PGRs were only statistically significant when both varieties were considered).*
- *In contrast, PGR application had only small effects on RGT Planet (small reductions in crop height and small differences in brackling and small increases in yield) that were in the main not significant.*
- *Grazing Cassiopee achieved a significant reduction in crop height (18cm) at flowering; compared to Moddus Evo at either rate which achieved a 13cm reduction in crop height*
- *There was significant interaction between PGR strategy and variety on plant height assessed at GS 63 (Cassiopee) and GS65 (RGT Planet)*
- *Grazing winter barley at GS30 produced significantly more dry matter than grazing spring barley that reached GS30 earlier in the winter*
- *There was no significant difference between lodging among treatments however there was a trend to less lodging with any treatment compared to the untreated.*

The spring barley RGT Planet was significantly higher yielding than the winter barley Cassiopee grown under overhead irrigation. Cassiopee was later to develop in the spring and subject to greater lodging (Table 1 & 3). PGR application based on Moddus Evo (Trinexapac ethyl) significantly reduced crop height and lodging but greater benefit in the winter barley Cassiopee which was more lodging prone (Table 2 & 3). Grazing had similar effects on crop height and lodging but the influence was greater on Cassiopee than RGT Planet, primarily as a result of later defoliation (took longer to reach GS30) and greater dry matter (Table 3 & 4).



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 1.** Influence of variety (winter v spring barley), PGR strategy and grazing on grain yield (t/ha).

| | Cultivar | | |
|---|---|---|---|
| | **RGT Planet** | **Cassiopee** | **Mean** |
| | **Yield t/ha** | **Yield t/ha** | **Yield t/ha** |
| Untreated | 7.15 - | 5.32 - | **6.23 b** |
| 200ml/ha Moddus Evo | 7.27 - | 6.57 - | **6.92 a** |
| 400ml/ha Moddus Evo | 7.33 - | 6.43 - | **6.88 a** |
| Grazed at GS30 | 7.33 - | 6.19 - | **6.76 a** |
| | | | |
| **Mean** | **7.27 a** | **6.13 b** | |
| | | | |
| **LSD Cultivar p = 0.05** | 0.30 | **P val** | <0.001 |
| **LSD PGR Strategy p=0.05** | 0.39 | **P val** | 0.033 |
| **LSD Cultivar x PGR P=0.05** | ns | **P val** | 0.154 |

*Yield figures followed by different letters are considered to be statistically different (p=0.05)*

**Table 2.** Influence of variety (winter v spring barley), PGR strategy and grazing on plant height (cm) - 29th September.

| | Cultivar and growth stage | | |
|---|---|---|---|
| | **RGT Planet (GS65)** | **Cassiopee (GS63)** | **Mean** |
| | **Height cm** | **Height cm** | **Height cm** |
| **Untreated** | 108 b | 115 a | **111 a** |
| **200ml/ha Moddus Evo** | 105 bc | 102 c | **104 b** |
| **400ml/ha Moddus Evo** | 101 c | 102 c | **102 b** |
| **Grazed at GS30** | 104 bc | 97 d | **101 b** |
| | | | |
| **Mean** | **105 -** | **104 -** | |
| | | | |
| **LSD Cultivar p = 0.05** | ns | **P val** | 0.4787 |
| **LSD PGR Strategy p=0.05** | 6.3 | **P val** | 0.0182 |
| **LSD Cultivar x PGR P=0.05** | 4.1 | **P val** | 0.0012 |

*Height figures followed by different letters are considered to be statistically different (p=0.05)*

**Table 3.** Influence of variety (winter v spring barley), PGR strategy and grazing on crop lodging (0 – 500 scale) - 28th October.

| | Cultivar | | |
|---|---|---|---|
| | **RGT Planet** | **Cassiopee** | **Mean** |
| | **Lodging 0-500** | **Lodging 0-500** | **Lodging 0-500 Yield t/ha** |
| Untreated | 71 - | 225 - | **148 -** |
| 200ml/ha Moddus Evo | 10 - | 62 - | **36 -** |
| 400ml/ha Moddus Evo | 0 - | 114 - | **57 -** |
| Grazed at GS30 | 26 - | 34 - | **30 -** |
| | | | |
| **Mean** | **27 b** | **109 a** | |
| | | | |
| **LSD Cultivar p = 0.05** | 57.7 | **P val** | 0.009 |
| **LSD PGR Strategy p=0.05** | ns | **P val** | 0.119 |
| **LSD Cultivar x PGR P=0.05** | ns | **P val** | 0.271 |

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The winter barley Cassiopee produced more dry matter at GS30 than RGT Planet with almost 2000kg/ha dry matter produced (Table 4). This is primarily the result of a longer vegetative period up to GS30 for dry matter production. The spring variety RGT Planet reached psuedo stem erect (GS30) (cut off for grazing in the vegetative phase) on 26th June Whilst Cassiopee reached the same growth stage on 31st July

**Table 4.** Influence of variety (winter v spring barley) on a single dry matter removal at GS30 (kg/ha DM).

| | | Dry matter (kg/ha) | | |
|---|---|---|---|---|
| **Cultivar** | **Grazing date and GS** | **Pre-graze** | **Post Graze** | **DM Removed** |
| | | **kg/ha** | **kg/ha** | **kg/ha** |
| RGT Planet | 26 June - GS30 | 1.14 - | 0.43 b | 0.72 - |
| Cassiopee | 31 July - GS30 | 2.83 - | 0.89 a | 1.94 - |
| | | | | |
| **LSD p=0.05** | | 1.75 | 0.29 | ns |
| **P val** | | 0.054 | 0.021 | 0.106 |

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# Kerang VIC

*Irrigated trials conducted at the Kerang irrigated research centre 2020 were managed by the Irrigated Cropping Council.*

## Trial 1 Nitrogen Use Efficiency Trial – Nitrogen Rates

**Protocol Objective:**
To compare and contrast plant growth regulation strategies in winter and spring barley germplasm.

**Location:** Kerang, Victoria
**Sown:** 17 April 2020
**Harvested:** 8 December 2020
**FAR Code:** ICC B20-03-2
**Cultivar:** Cassiopee
**Rotation position:** Dryland vetch/brown manure 2019
**Soil Type:** Neutral medium red clay
**Irrigation:** Flood irrigation 4 applications totalling 400mm (4.0 ML/ha)
**GSR:** April-October 250mm. Total water available 650mm

***Key Messages:***

- *By GS33 visual responses to the applied N were apparent (crop height). However shoot numbers were consistent across all treatments*
- *Shoot loss between GS33 and GS65 was approximately 60% across the 0, 160 and 320 kg N/ha treatments – higher rates of N did not maintain shoot numbers.*
- *Lodging began shortly after flowering, beginning with the high N plots. By harvest all plots were affected by either lodging, brackling or both.*
- *Highest yielding treatments were those that received 80 – 200 kg N/ha. 0 or high rates of N decreased yield.*
- *As a general trend, higher applied N resulted in higher grain protein and lower retention.*

**Table 1.** Dry matter and shoot numbers and accumulated plant N for selected treatments assessed at GS30 (5 August), GS33 (10 September) and GS65 (9 October).

| **Treatments** | | | | | | |
|---|---|---|---|---|---|---|
| **Applied N** | GS30 | GS33 | | GS65 | | |
| | DM (t/ha) | DM (t/ha) | Shoots/m$^2$ | DM (t/ha) | Shoots/m$^2$ | Accumulated N (kg N/ha) |
| **0 kg N/ha** | 2.23 | 7.37 | 1006 | 12.09 | 352 | 134 a |
| **160 kg N/ha** | ---- | 7.54 | 940 | 14.13 | 357 | 244 b |
| **320 kg N/ha** | ---- | 8.02 | 1040 | 13.61 | 390 | 325 c |
| **P val** | | 0.803 | 0.272 | 0.06 | 0.356 | <0.001 |
| **LSD** | | NS | NS | NS | NS | 34.3 |
| **cv%** | | 18.4 | 6.2 | 7.4 | 10.3 | 8.5 |

Soil N at sowing was 97 kg N/ha (0-60 cm) and at GS30, had been reduced to 20 kg N/ha in the '0' treatment plots prior to the first N application.

The N content of the '0' treatment at GS65 of 134 kg N/ha seems consistent with the amount of N in the soil and that added with the starter fertiliser. Assuming the '0' treatment as the base, then the



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'320 kg N/ha' treatment took up 191 kg N/ha (60%) and the '160 kg N/ha' treatment took up 110 kg N/ha (69%) of the N applied, calculated by subtracting the 'base N' from that measured in the '320' and '160' treatments.

Higher N application did not result in higher grain yield and generally contributed to poorer retention.

**Table 2.** Yield and grain quality.

| Treatment | Yield (t/ha) | Protein (%) | Retention (%) | Test Weight (kg/hl) |
|---|---|---|---|---|
| 0 kg N/ha | 6.25 bc | 9.8 d | 94.5 a | 62.0 |
| 80 kg N/ha | 7.15 a | 11.3 c | 87.5 ab | 62.5 |
| 120 kg N/ha | 7.15 a | 12.3 c | 86.9 ab | 62.0 |
| 160 kg N/ha | 6.89 ab | 13.8 b | 86.7 abc | 62.9 |
| 200 kg N/ha | 6.89 ab | 14.8 b | 82.9 bcd | 62.5 |
| 240 kg N/ha | 6.06 c | 15.7 ab | 79.0 cd | 61.8 |
| 280 kg N/ha | 6.26 bc | 16.1 a | 76.3 d | 61.5 |
| 320 kg N/ha | 6.20 bc | 16.1 a | 80.8 bcd | 63.6 |
| **P val** | 0.012 | <0.001 | 0.003 | 0.594 |
| **LSD** | 0.713 | 1.115 | 7.783 | NS |
| **cv%** | 7.3 | 5.5 | 6.3 | 2.4 |

**Figure 1.** Taken 20 October – GS 77. '320 kg N/ha plot on the left, '120 kg N/ha' plot on the right.

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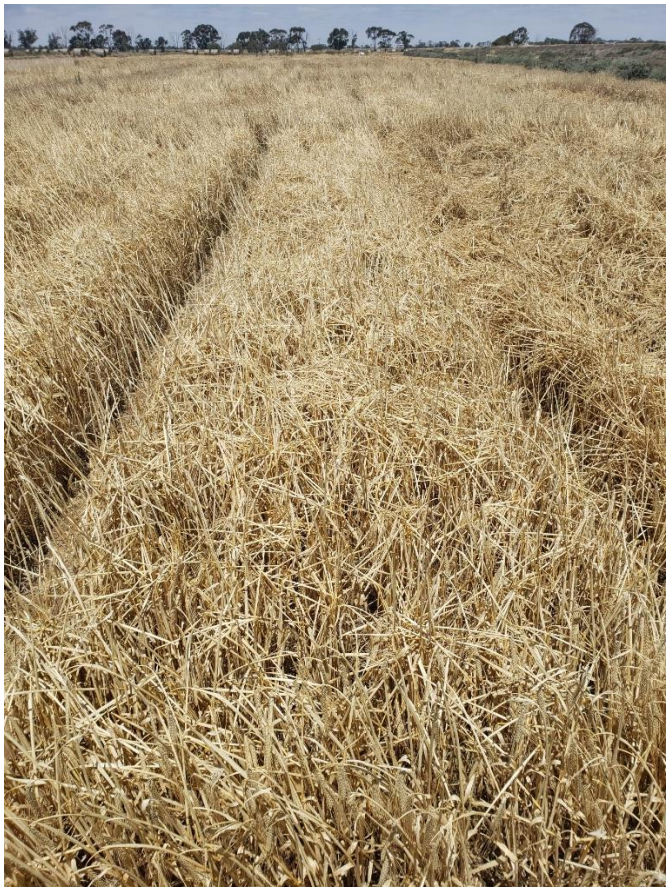

**Figure 2.** Brackling in the ’80 kg N/ha’ treatment prior to harvest. The plot on the right is a ‘320 kg N/ha) treatment demonstrating lodging as well.



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Optimising Irrigated Grains

# Optimising Irrigated Grains (FAR1906-003RTX)

**A Grains Research & Development Corporation (GRDC) investment**

## PROVISIONAL HARVEST RESULTS:

# Irrigated Soil Amelioration Trials

NSW GOVERNMENT Department of Primary Industries

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# Finley Irrigated Research Centre NSW

*Irrigated trials conducted at the Finley irrigated research centre 2020 were managed by FAR Australia, hosted by Southern Growers.*

## Trial 1 Influence of Soil Amelioration and Soil Amendments on Faba Bean Yield and Profitability

**Location:** Finley IRC
**FAR Code:** FAR F20-06a-1
**Sown:** 19 May 2020
**Cultivar:** PBA Samira
**Seed rate:** 170 kg/ha
**Harvested:** 30th November 2020
**Rotation position:** Fallow (2019), Faba beans (2018), Wheat (2017)
**Soil Management:** Cultivation with speed disc to level site after amelioration treatments in Autumn
**GSR/Irrigation:** Overhead lateral irrigation 6 x 25mm in spring. Total applied 150mm
**GSR:** April-October 244mm. Total water available 394mm

**Key Messages:**

- All treatments tested significantly out yielded the untreated control.
- There was no significant difference between the amelioration and amendment treatments, however there was a trend for treatments with organic amendment (15t/ha Lucerne pellets) applied to be higher yielding than their respective treatments without organic amendment.
- Though not statistically superior to other amendments, the highest grain yields were where gypsum and organic amendment were deep applied (35-40cm) together.
- Deep ripping alone to the same depth led to an increase in grain yield of 1.02 t/ha.
- Surface applied organic amendment based on lucerne pellets at 15t/ha gave a 0.65 t/ha grain yield advantage over the control treatment, the lowest of treatments tested but not statistically different.
- There were no significant differences in dry matter production or canopy architecture observed among the different treatments.
- Crop reflectance measurements at flowering using NDVI (0 – 1 scale) showed significantly greater canopy greenness where the organic amendment had been surface applied, where it was deep ripped with gypsum and where gypsum was deep ripped alone. *Note with the surface applied amendment being green in colour this could have influenced the results.*

**Ripping Details**

Ripping at the Finley site was conducted on 16, 17 & 18 March 2020. Ripping was achieved to a depth of 35-40cm. For reps 1 & 3, 3 passes were required to get to depth (2 passes pre-amendment plus 1 to apply amendment); and for reps 2 & 4, 2 passes were required (1 pass pre-amendment plus 1 to apply amendment). The deep applied organic amendment + deep applied gypsum required an extra pass to deliver the second product as the machine used was not able to apply two products together.



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**Table 1.** Influence of soil amelioration and soil amendments on crop yield (t/ha) and grain protein (%).

| | | Grain yield and quality | |
|---|---|---|---|
| | | Yield | Protein |
| | **Treatment Rate** & Timing (Conducted 17-Mar 2020) | t/ha | % |
| **1.** | Nil (Control) | 4.85 c | 13.0 - |
| **2.** | Deep rip (tillage control) | 5.87 ab | 13.4 - |
| **3.** | Surface applied organic amendment (15t/ha) | 5.51 b | 13.0 - |
| **4.** | Deep rip; Deep applied organic amendment | 6.03 ab | 12.9 - |
| **5.** | Deep rip; Deep applied organic amendment; Deep applied gypsum | 6.17 a | 13.3 - |
| **6.** | Deep applied gypsum | 5.68 ab | 12.6 - |
| | **Mean** | **5.65** | **13.0** |
| | **LSD** | 0.54 | 0.5 |
| | **P val** | 0.002 | 0.068 |

*Organic amendment based on Lucerne pellets applied at 15t/ha, Gypsum applied at 5t/ha, Deep ripping conducted to a depth of 35-40cm after 3 passes.*

**Table 2.** Influence of soil amelioration and soil amendments on crop reflectance measured as normalised differential vegetation index (NDVI) on 0 -1 scale – GS 22 15-Jul, GS62 10-Sep.

| | | Normalised differential vegetation index (NDVI) | |
|---|---|---|---|
| | **Treatment** | **GS22 (early vegetative)** | **GS62 (early flower)** |
| | | **(0-1)** | **(0-1)** |
| **1.** | Nil (Control) | 0.315 - | 0.533 c |
| **2.** | Deep rip (tillage control) | 0.310 - | 0.545 bc |
| **3.** | Surface applied organic amendment | 0.318 - | 0.588 a |
| **4.** | Deep rip; Deep applied organic amendment | 0.300 - | 0.543 bc |
| **5.** | Deep rip; Deep applied organic amendment; Deep applied gypsum | 0.303 - | 0.573 a |
| **6.** | Deep applied gypsum | 0.300 - | 0.563 ab |
| | **Mean** | **0.308** | **0.557** |
| | **LSD** | ns | 0.026 |
| | **P val** | 0.465 | 0.004 |



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**Table 3.** Influence of soil amelioration and soil amendments on dry matter production at GS63 and harvest (t/ha) and canopy composition pods/m2 and height to first pod (cm) – assessed at flowering GS63 (10 Sep) and harvest (26 Nov).

| | | Dry Matter Production | | Canopy Architecture | |
|---|---|---|---|---|---|
| | | GS 63 | Harvest | Pod Count | 1st Pod Height |
| | | t/ha | t/ha | pod/m2 | cm |
| **1.** | Nil (Control) | 2.93 - | 11.36 - | 435 - | 21.9 - |
| **2.** | Deep rip (tillage control) | 2.98 - | 11.13 - | 446 - | 22.7 - |
| **3.** | Surface applied organic amendment | 3.21 - | 10.46 - | 456 - | 20.3 - |
| **4.** | Deep rip; Deep applied organic amendment | 2.91 - | 11.13 - | 424 - | 24.4 - |
| **5.** | Deep rip; Deep applied organic amendment; Deep applied gypsum | 2.99 - | 12.65 - | 479 - | 22.3 - |
| **6.** | Deep applied gypsum | 3.07 - | 12.98 - | 518 - | 22.0 - |
| | **Mean** | **3.01** | **11.62** | **460** | **22.2** |
| | **LSD** | ns | ns | ns | ns |
| | **P val** | 0.781 | 0.553 | 0.360 | 0.826 |

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# Kerang VIC

*Irrigated trials conducted at the Kerang irrigated research centre 2020 were managed by the Irrigated Cropping Council.*

## Trial 1 Influence of Soil Amelioration and Soil Amendments on Faba Bean Yield and Profitability

**Location:** Noorong, NSW
**FAR Code:** ICC O20-06a-2
**Sown:** 24 April 2020
**Cultivar:** Wizard forage oats
**Harvested:** Windrowed 19 November (to prevent grain loss)
**Rotation position:** Dryland vetch/brown manured 2019
**Soil Type:** Neutral heavy grey clay, bordercheck.
**Irrigation:** Flood irrigation 2 applications totalling 270m (2.7 ML/ha)
**GSR:** April-October 240mm. Total water available 510mm

***Key Messages:***

- *The ameliorants were placed shallower than planned due to the inability of the ripper to penetrate deeper than 30-32 cm despite 3 passes. The soil was not at the ideal moisture level for ripping and risked damaging the ripper if more power was applied.*
- *The application of the organic ameliorant had the most effect on crop biomass and grain yield.*
- *The site had very low soil N early in the season and so mineralisation of the organic ameliorant resulted noticeable increased vegetative growth and eventually grain yield.*
- *The N released through mineralisation resulted in lodging of the treatments.*
- *Grain yield and biomass was improved over the untreated control by all of the amelioration treatments.*

**Table 1:** Trial treatment summary. Ripping occurred over a three-day period (March 20-23, with treatments applied on March 24. Ripping depth achieved was 30-32 cm.

| Trt. | | Amendment rate |
|---|---|---|
| **1** | Untreated control | - |
| **2** | Deep rip only | - |
| **3** | Surface applied organic amendment (lucerne pellets) | 15 t/ha |
| **4** | Dep applied organic amendment | 15 t/ha |
| **5** | Deep applied organic amendment and gypsum | 15 t/ha + 5 t/ha |
| **6** | Deep applied gypsum | 5 t/ha |



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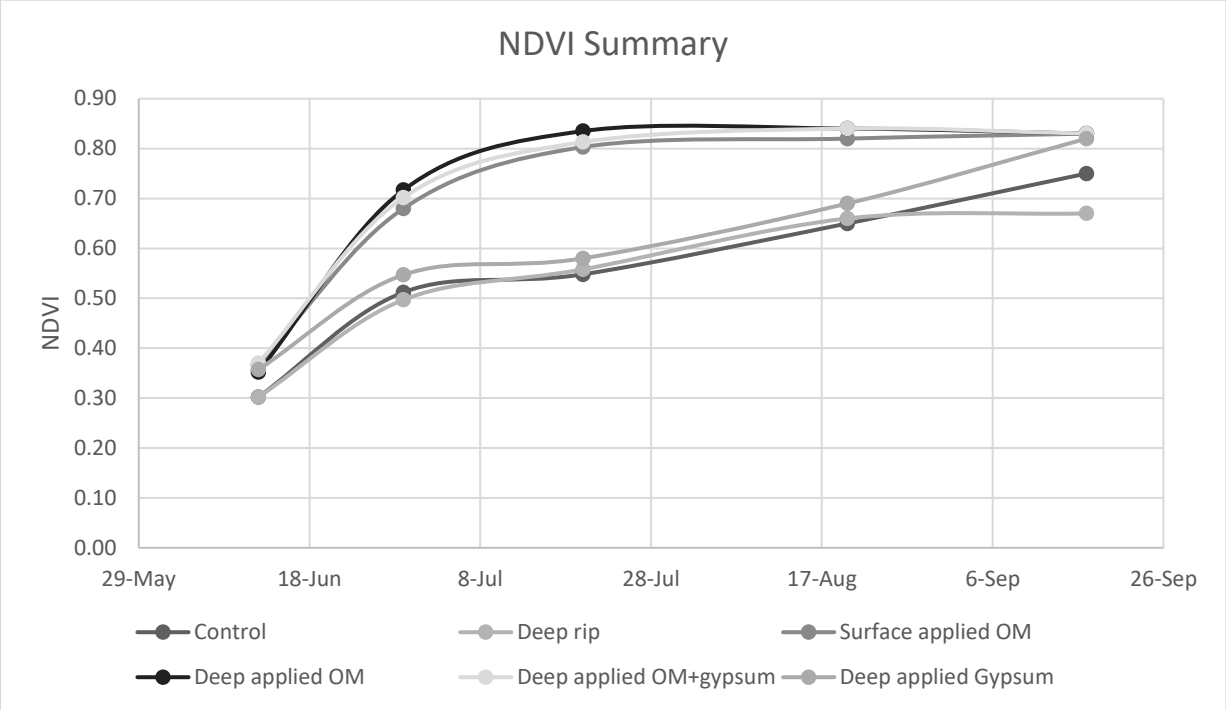


**Figure 1.** NDVI measurement June – September.

The site was pre-irrigated in early April, shortly after the treatments had been applied, and above average rainfall for April made the trial site quite wet/waterlogged during emergence.
Soil cores taken in early June from an untreated area of the paddock had very little N in the profile (12 kg N/ha 0-60 cm).
The treatments that received the organic ameliorant demonstrated far more growth as indicated by the NDVI measurements through the winter period. By 20 August, there was no significant difference between treatment NDVI readings, but there was a still a strong visual response. By 18 September the treatment effects on crop height were still visible, but not to the same degree as in August.



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**Figure 2.** Plants from the control (LHS) and Treatment 5 (RHS) 20 August

**Figure 3.** Plants taken from Replicate 4 on 18 September. L-R; treatment 5, 4, 1, 2, 6, 3. Stick is 50 cm

**Table 2**: Canopy measurements – plant populations (plants/m2), dry matter at flowering and windrowing (t/ha).

| Treatment | Plant population | Dry matter GS69* | | Dry matter GS87 | | Heads/m2 GS85 | |
|---|---|---|---|---|---|---|---|
| **1 Control** | 168 pl/m$^2$ | 10.71 | b | 7.38 | c | 381 | c |
| **2** | 193 pl/m$^2$ | 8.86 | b | 12.7 | b | 586 | bc |
| **3** | 185 pl/m$^2$ | 13.10 | a | 14.93 | ab | 772 | ab |
| **4** | 199 pl/m$^2$ | 12.74 | a | 16.85 | a | 880 | a |
| **5** | 196 pl/m$^2$ | 12.86 | a | 14.49 | ab | 652 | ab |
| **6** | 198 pl/m$^2$ | 10.37 | b | 13.69 | ab | 726 | ab |
| P val | 0.769 | 0.002 | | <0.001 | | 0.009 | |
| LSD | NS | 2.012 | | 3.325 | | 234.7 | |
| cv% | 17.8 | 11.7 | | 16.6 | | 23.5 | |

*From replicates 3 & 4 due to inaccessibility after irrigation.

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The influence of the organic ameliorant (OA) continued at late flowering with the higher biomass. Where it had been buried in the rip line (treatments 4 and 5), lodging was already beginning to occur. A similar pattern in biomass and heads/$m^2$ emerged at windrowing to that at GS69.

**Table 3.** Oat yield (t/ha) and grain size (g/100 seeds).

| Treatment | Yield (t/ha) | Lodging Score | Harvest Index |
|---|---|---|---|
| **1 Control** | 2.63 c | 0.3 a | 0.33 a |
| **2** | 3.51 ab | 0.3 a | 0.25 b |
| **3** | 4.06 a | 1.8 b | 0.25 b |
| **4** | 3.95 a | 4.0 c | 0.21 b |
| **5** | 2.87 b | 4.5 c | 0.18 b |
| **6** | 3.50 ab | 0.8 a | 0.24 b |
| P val | 0.02 | <0.001 | 0.017 |
| LSD | 0.883 | 0.94 | 0.073 |
| cv% | 17.1 | 32.5 | 20.2 |

Highest yielding treatment was where 15 t/ha of OA (lucerne pellets) was placed in the rip line alone, but was not statistically different to the other treatments apart from Treatments 1 (control) and 5.
The untreated control had the lowest yield. Ripping alone did improve yield, as demonstrated by Treatment 2, as did applying N alone in the form of an OA, as in Treatment 3.
The treatments that did not receive the OA lagged through the vegetative stage of the crop development but grain yields were not significantly different to the OA treatments.
Lodging, which started to occur well before flowering in the 'rip + OA' treatments may have impacted yield. Treatment 5 had a low Harvest Index suggesting there was sufficient biomass for a higher yield but did not eventuate.



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# Appendix

## Finley Irrigated Research Centre NSW

### Meteorological Data

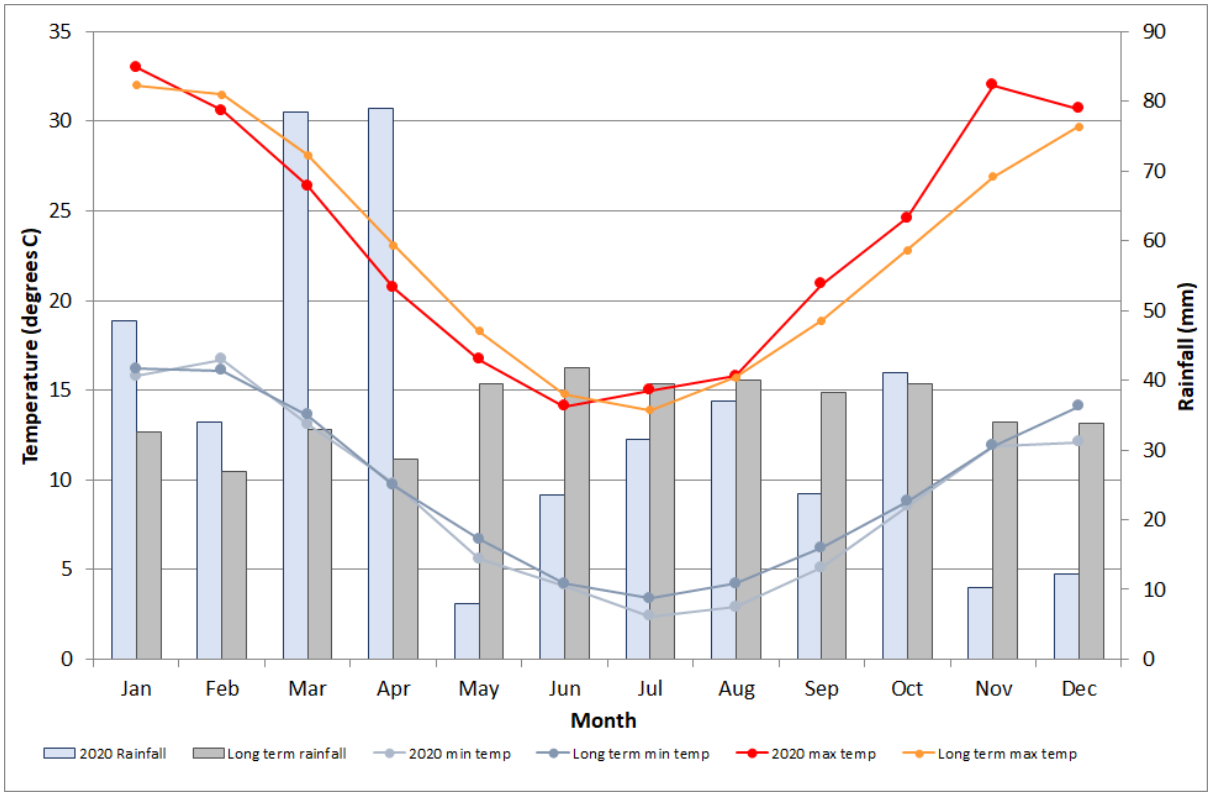


**Figure 1.** 2020 annual rainfall and long-term rainfall (1897-2020) (recorded at Finley), 2020 min and max temperatures and long-term min and max temperatures (1970-2020) (recorded at Tocumwal Airport). Rainfall April to October= 244.0mm. For the period July-December, temperatures were monitored on site. Minimum temperatures were found to be 1 degree Celsius cooler and maximums 1 degree Celsius warmer on site than at Tocumwal Airport 21.5 Km away.

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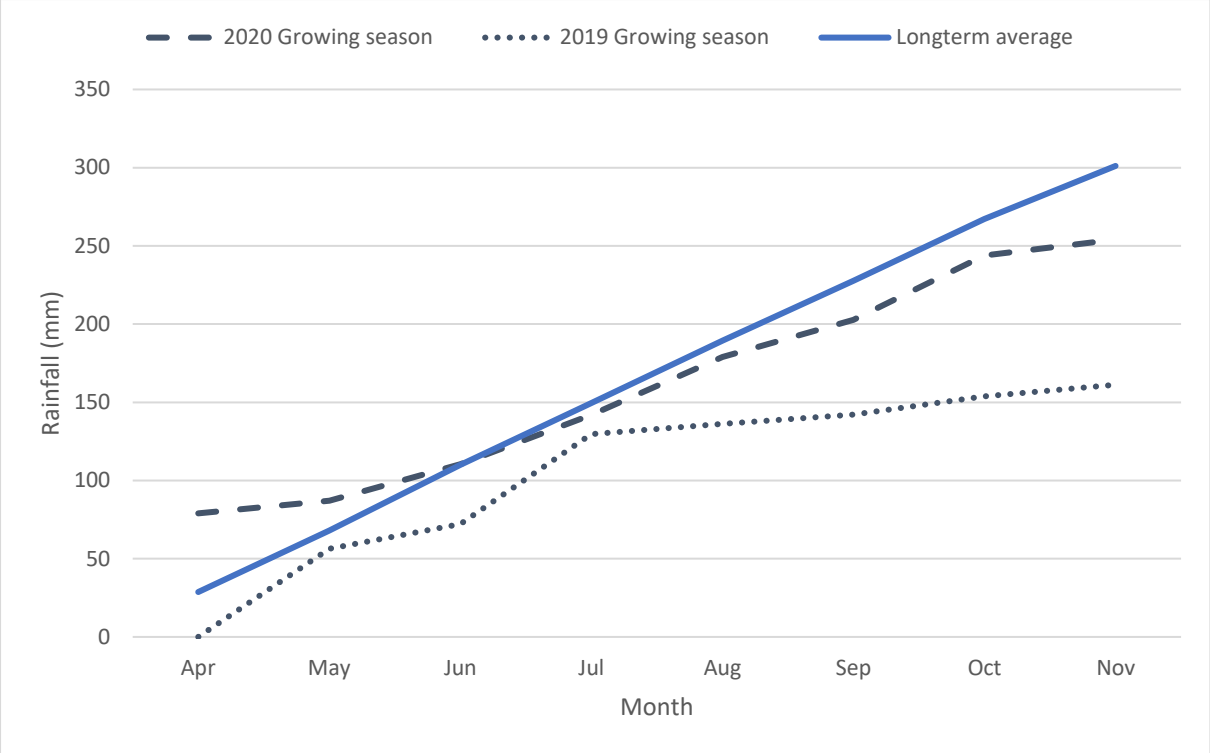


**Figure 2.** Cumulative growing season rainfall (April-November) for 2020, 2019, and the long-term average.



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## Irrigation Schedule

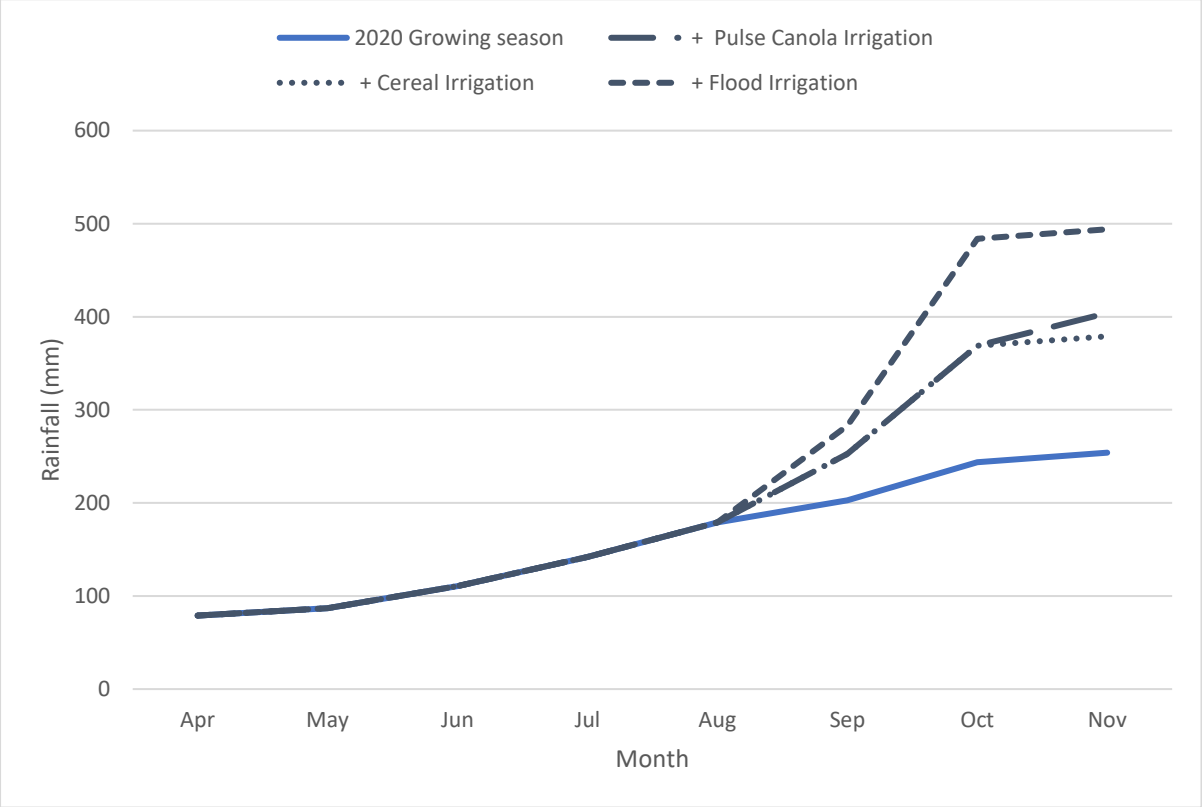


**Figure 1.** Cumulative 2020 growing season rainfall (April-November) plus irrigation delivered to cereal crops, pulse and canola crops and crops grown on flood irrigation.

### *Overhead Irrigation*

**Table 1.** Faba bean irrigation schedule.

| Date of application | Irrigation applied (mm) | Growth Stage | Plant available moisture pre irrigation | Plant available moisture post irrigation |
|---|---|---|---|---|
| 7 Sep | 25 | GS63 | 67 | 96 |
| 17 Sep | 25 | GS64 | 67 | 98 |
| 5 Oct | 25 | GS74 | 62 | 94 |
| 15 Oct | 25 | GS76 | 63 | 94 |
| 29 Oct | 25 | GS79 | 62 | 91 |
| 10 Nov | 25 | GS81 | 63 | 93 |



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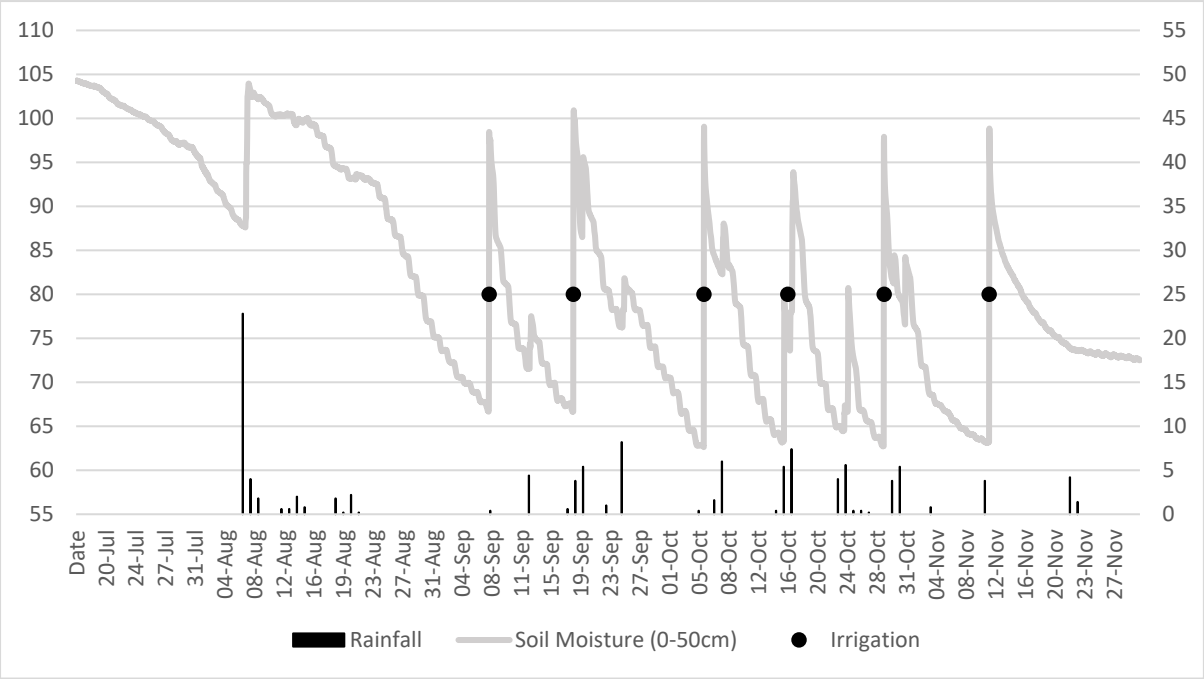


**Figure 1.** Linear overhead irrigation summed soil moisture data under faba beans (0-50cm).

**Table 2.** Chickpea irrigation schedule.

| Date of application | Irrigation applied (mm) | Growth Stage |
|---|---|---|
| 7 Sep | 25 | V18 |
| 17 Sep | 25 | V20 |
| 5 Oct | 25 | R2 |
| 15 Oct | 25 | R4 |
| 29 Oct | 25 | R5 |
| 11 Nov | 25 | R6 |

**Table 3.** Durum irrigation schedule.

| Date of application | Irrigation applied (mm) | Growth Stage |
|---|---|---|
| 7 Sep | 25 | GS40 |
| 17 Sep | 25 | GS43 |
| 5 Oct | 25 | GS61 |
| 15 Oct | 25 | GS71 |
| 29 Oct | 25 | GS83 |

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**Table 4.** Canola irrigation schedule. Unless otherwise stated canola trials received 125 or 150 mm/ha as overhead irrigation (1.25 – 1.5 Mega L/ha) either 5 or 6 applications. Trials 1, 5 and 6 that received 125mm/ha irrigation whilst trials 3 & 4 received 150mm/ha with an additional final irrigation applied on 11 November.

| Date of application | Irrigation applied (mm) | Growth Stage | Plant available moisture pre irrigation | Plant available moisture post irrigation |
|---|---|---|---|---|
| 8 Sep | 25 | GS67 | 73 | 97 |
| 18 Sep | 25 | GS68 | 75 | 101 |
| 6 Oct | 25 | GS69 | 70 | 97 |
| 16 Oct | 25 | GS77 | 68 | 99 |
| 29 Oct | 25 | GS79 | 70 | 102 |
| 11 Nov | 25 | GS87 | 70 | 97 |

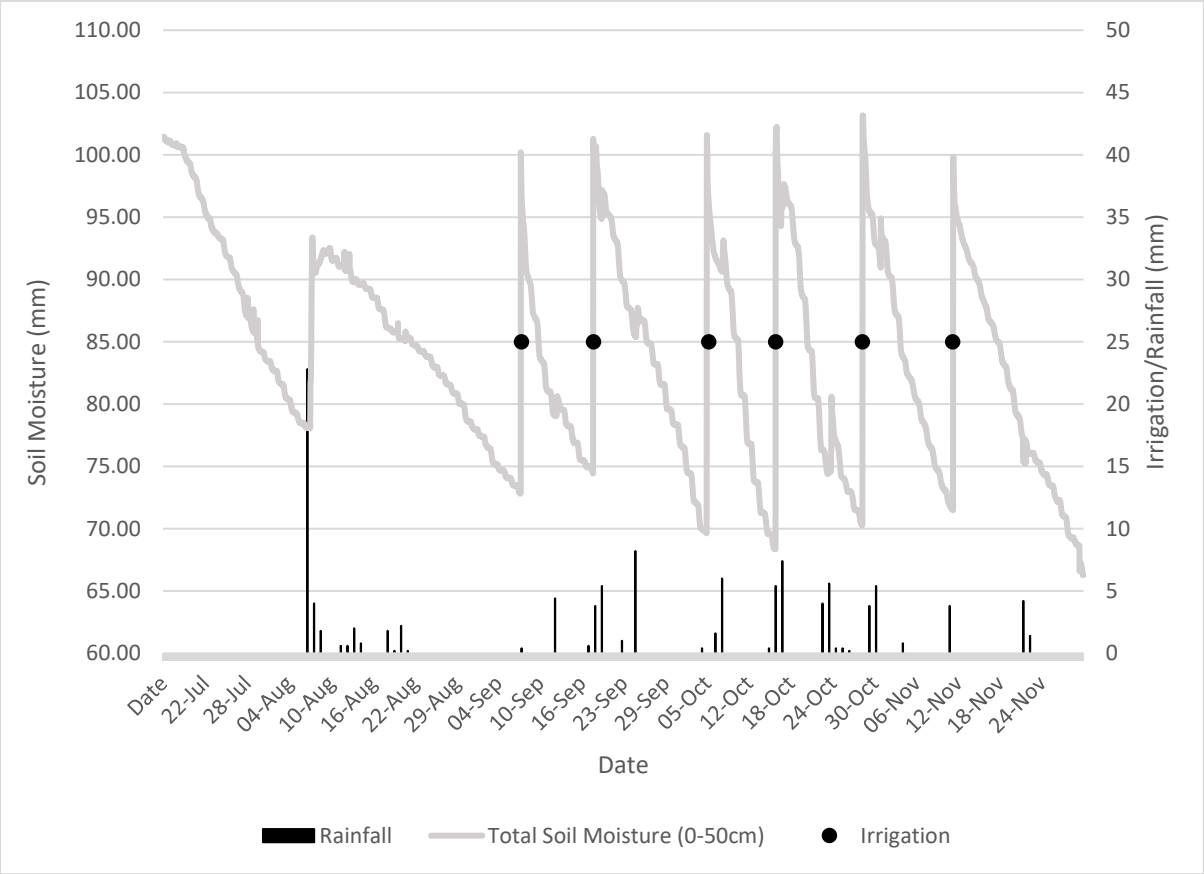


**Figure 2.** Overhead irrigation summed soil moisture data (0-50cm) for canola showing the effect of 6 x 25 mm/ha (total 150mm) irrigation under trial 3 & 4.

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**Table 5.** Barley irrigation schedule.

| Date of application | Irrigation applied (mm) | Growth Stage (planet/cassiopee) | Plant available moisture pre irrigation | Plant available moisture post irrigation |
|---|---|---|---|---|
| 7 Sep | 25 | GS 32/49 | 67 | 90 |
| 17 Sep | 25 | GS 43/60 | 72 | 86 |
| 5 Oct | 25 | GS 71/73 | 68 | 83 |
| 15 Oct | 25 | GS 77/85 | 69 | 82 |
| 29 Oct | 25 | GS 85/87 | 68 | 87 |

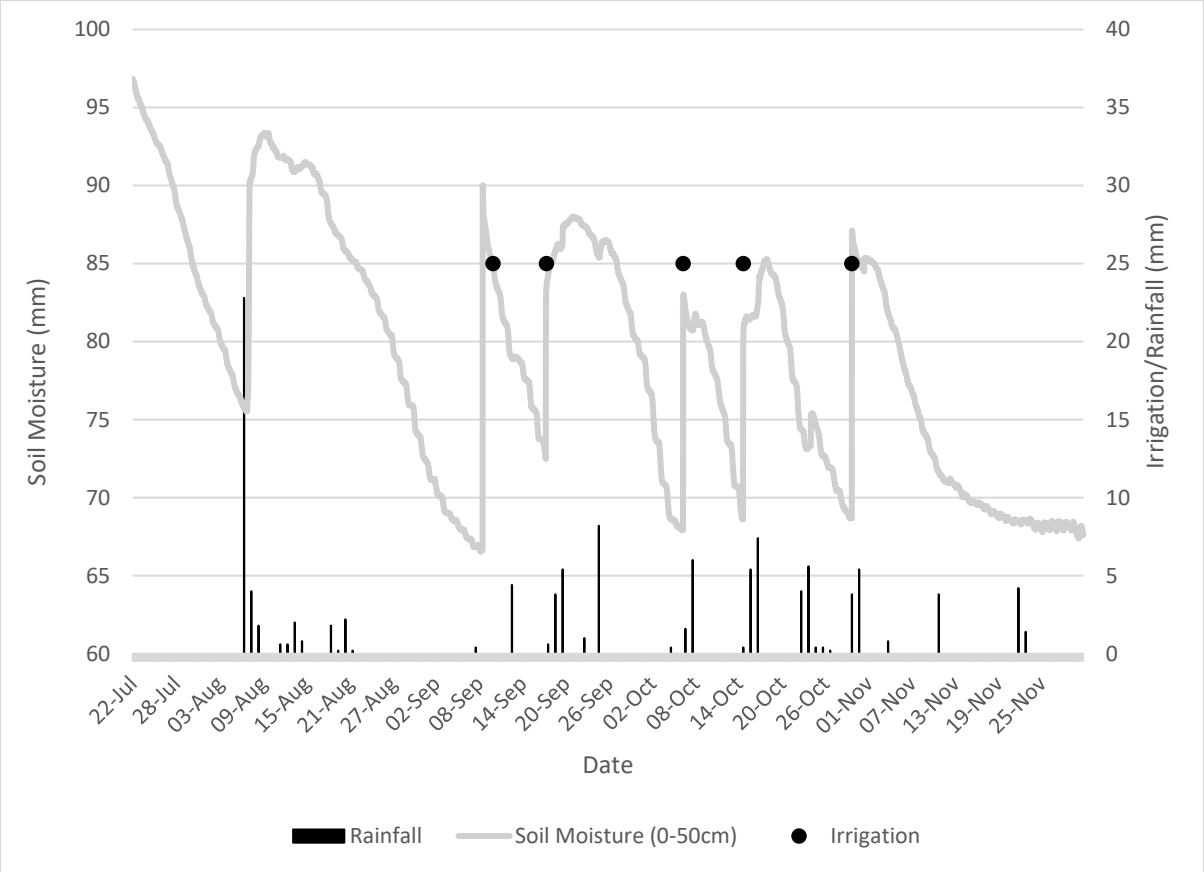


**Figure 3.** Linear irrigation over barley summed soil moisture data (0-50cm).

*Flood Irrigation*

**Table 1.** Faba bean irrigation schedule.

| Date of application | Irrigation applied (mm) | Growth Stage |
|---|---|---|
| 10 Sep | 80 | GS64 |
| 4 Oct | 80 | GS74 |
| 28 Oct | 80 | GS79 |



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**Table 2.** Durum irrigation schedule.

| Date of application | Irrigation applied (mm) | Growth Stage | Plant available moisture pre irrigation | Plant available moisture post irrigation |
|---|---|---|---|---|
| 10 Sep | 80 | GS41 | 94 | 160 |
| 4 Oct | 80 | GS61 | 112 | 160 |
| 28 Oct | 80 | GS80 | 101 | 153 |

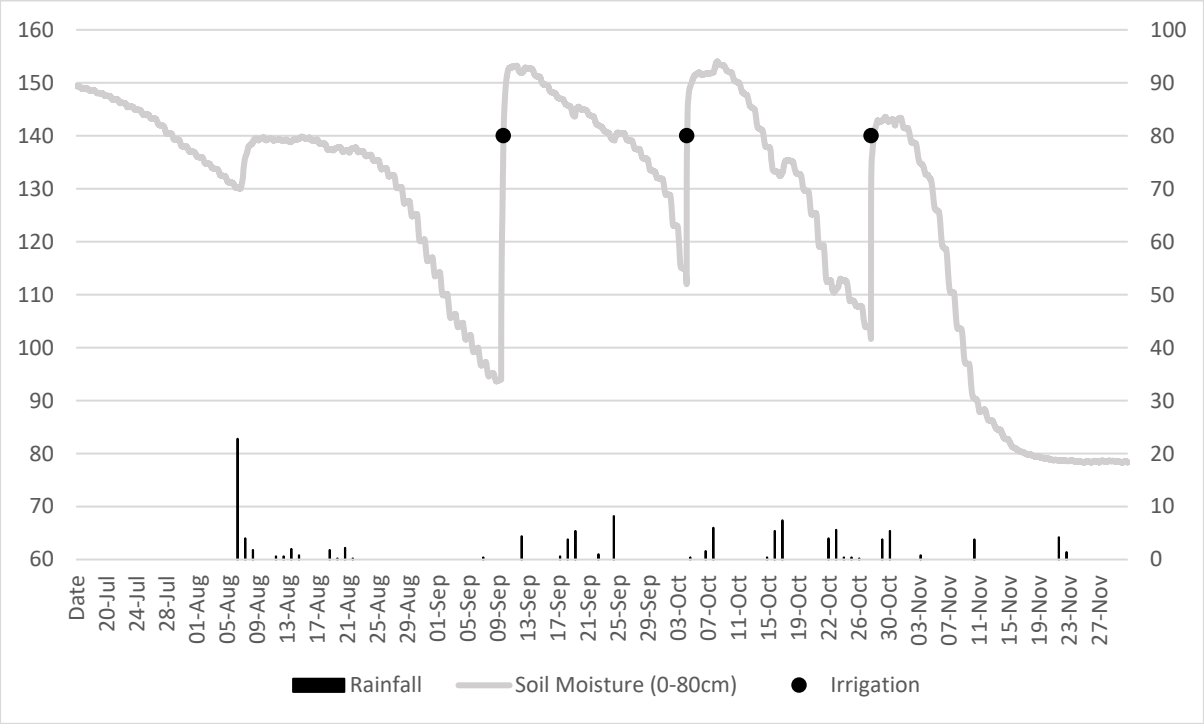


Figure 1. **Durum flood irrigation summed soil moisture data (0-80cm).**

**Table 3.** Canola irrigation schedule. Trial 2 on the flood bays received 240mm of irrigation as three applications of 80mm see table below.

| Date of application | Irrigation applied (mm) | Growth Stage |
|---|---|---|
| 10 Sep | 80 | GS68 |
| 4 Oct | 80 | GS69 |
| 28 Oct | 80 | GS79 |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Crop Inputs

**Table 1.** Faba bean trial inputs. Unless otherwise indicated by the treatment list in the individual trials the following inputs were applied to the faba bean trials at the Finley Irrigated Research Centre.

| | | | |
|---|---|---|---|
| **Sowing date:** | | | 28 April |
| **Variety:** | | | Variable |
| **Seed Rate:** | | | 24 Seeds/$m^2$ |
| **Sowing Fertiliser:** | | | 120kg MAP |
| **Seed Treatment** | | | P-Pickel T @ 200 mL per 100 kg |
| **Innoculation:** | | | Nodulator Group E& F granular 10kg/ha |
| **Herbicide:** | 27-Apr | Pre-sow | Trifluralin (500g/l) 2.0l/ha |
| | 6-May | Pre-em | Spinnaker 70g/ha |
| | 11-Jun | GS14 | Clethodim 0.3l/ha |
| **Fungicide:** | 1-Aug | 12 node | Tebuconazole 145 ml/ha |
| | 21-Sep | GS71 | Veritas 1.0 l/ha |

**Table 2.** Chickpea trial inputs. Unless otherwise indicated by the treatment list in the individual trials the following inputs were applied to the chickpea trials at the Finley Irrigated Research Centre.

| | | | |
|---|---|---|---|
| **Sowing date:** | | | **Variable** |
| **Variety:** | | | Variable |
| **Seed Rate:** | | | 30 seeds/$m^2$ |
| **Sowing Fertiliser:** | | | 120kg MAP |
| **Seed Treatment** | | | P-Pickel T @ 200 mL per 100 kg |
| **Herbicide:** | 27 Apr | Pre-sow | Trifluralin (500g/l) 2.0l/ha |
| | 6 May | Pre-em | Spinnaker 45g/ha |
| | 6 May | Pre-em | Simazine (900g/ka) 0.55kg/ha |
| | 11 Jun | V6 | Clethodim 0.3l/ha |
| **Nitrogen:** | | | none |
| **Fungicide:** | 27 Aug | V19 | Aviator 650 ml/ha |
| | 2 Oct | R3 | Veritas 1.0 l/ha |
| **PGR:** | | | none |



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**Table 3.** Durum trial inputs. Unless otherwise indicated by the treatment list in the individual trials the following inputs were applied to the durum trials at the Finley Irrigated Research Centre.

| | | | |
|---|---|---|---|
| **Sowing date:** | | | 19-May |
| **Variety:** | | | Variable |
| **Seed Rate:** | | | 180 seeds/$m^2$ |
| **Sowing Fertiliser:** | | | 120kg/ha MAP |
| **Seed Treatment:** | | | Vibrance at 360ml/100kg Seed, Gaucho at 120ml/100kg |
| **Herbicide:** | 23 Apr | Pre-sow | Glyphosate 540, 1.67l |
| | 6 May | Pre-sow | Paraquat 1.67l |
| | 19 May | Pre-sow | Paraquat 1.67l |
| | 19 May | Pre-sow | Boxer Gold 2.5l |
| **Insecticide:** | 17 Jul | GS23 | Cyhella, 80 ml/ha |
| **Nitrogen:** | 5 Aug | GS31 | 217 kg/ha Urea (100 Kg N) |
| | 3 Sep | GS39 | 217 kg/ha Urea (100 Kg N) |
| **Fungicide:** | 1 Sep | GS39 | Prosaro, 300 ml/ha |
| | 21 Sep | GS49 | Amistar Xtra, 400 ml/ha |
| **PGR:** | 4 Sep | GS39 | Errex, 1.3 l/ha |

**Table 4**. Canola trial inputs. Unless otherwise indicated by the treatment list in the individual trials the following inputs were applied to the canola trials at the Finley Irrigated Research Centre.

| | | | |
|---|---|---|---|
| **Sowing date:** | | | 27-28 April |
| **Variety:** | | | Variable |
| **Seed Rate:** | | | 50 seeds/$m^2$ |
| **Sowing Fertiliser:** | | | 120kg/ha MAP |
| **Seed Treatment** | | | ATR Bonito (Cruiser Opti + Maxim XL) HyTTec® Trophy – (Poncho + Maxim), 45Y28 RR – (Jockey + Poncho), Nuseed Diamond – (Poncho Plus + Saltro Duo) |
| **Herbicide:** | 27-Apr | Pre-sow | Trifluralin (500g/l) 2.0l/ha |
| | 11-Jun | GS14 | Clethodim 0.3l/ha |
| **Nitrogen:** | 12-Jun | GS14 | 46 Kg N |
| | 1-Jul | GS16 | 100 Kg N |
| | 5-Aug | GS56 | 150 Kg N |
| **Fungicide:** | 17-Jul | GS18 | Prosaro 375ml |
| | 27-Aug | GS63 | Aviator Xpro 650ml |
| **PGR:** | | | Nil |

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The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 5.** Barley trial inputs. Unless otherwise indicated by the treatment list in the individual trials the following inputs were applied to the barley trials at the Finley Irrigated Research Centre.

| | | | |
|---|---|---|---|
| **Sowing date:** | | | 24-April |
| **Variety:** | | | RGT Planet & Cassiopee |
| **Seed Rate:** | | | 180 seeds/$m^2$ |
| **Sowing Fertiliser:** | | | 120kg MAP |
| **Seed Treatment:** | | | RGT Planet – Evergol Energy, Cassiopee - Vibrance + Gaucho |
| **Herbicide:** | 23-Apr | Pre-sow | Glyphosate 540, 1.67l |
| | 23-Apr | Pre-sow | Boxer Gold 2.5l |
| | | | |
| **Insecticide:** | 17-Jul | GS29/31 (P/C) | Cyhella, 80 ml/ha |
| | | | |
| **Nitrogen:** | 5-Aug | GS31/33 (P/C) | 80 Kg N |
| | 3-Sep | GS32/49 (P/C) | 80 Kg N |
| **Fungicide:** | 17-Jul | GS31 (P) | Prosaro 300ml |
| | 27-Aug | GS39 (P) | Aviator Xpro 416ml |
| | 27-Aug | GS32 (C) | Prosaro 300ml |
| | 21-Sep | GS43 (C) | Aviator Xpro 416ml |
| | | | |
| **PGR:** | 4 Sep | GS32 (C) | Variable |

*Growth stages – P=RGT Planet, C=Cassiopee*

## Soil Test Results

**Table 1**. Faba bean.

| **Paddock Name** | | **Flood - Trial 2** | | | **Overhead Trials, 1, 3,4,5 and amelioration** | | |
|---|---|---|---|---|---|---|---|
| **Sampling Date** | | 12/05/2020 | | | 12/05/2020 | | |
| **Sample Depth** | | 0-30 cm | 30-60 cm | 60-90 cm | 0-30 cm | 30-60 cm | 60-90 cm |
| **Soil Colour** | | Brown | Red | Orange / Yellow | Brown | Brown | Orange / Yellow |
| **Soil Texture** | | Clay | Clay | Clay | Clay | Clay | Clay |
| **Nitrate Nitrogen** | mg/kg | 48 | 13 | 8.5 | 19 | 4.3 | 2.4 |
| **Ammonium Nitrogen** | mg/kg | 2.6 | <0.6 | 0.9 | 5.9 | <0.6 | 0.8 |
| **Nitrate Nitrogen** | kg/ha | 187 | 51 | 33 | 74 | 17 | 9 |
| **Ammonium Nitrogen** | kg/ha | 10 | | 4 | 23 | | 3 |
| **Total N** | kg/ha | 197 | 51 | 37 | 97 | 17 | 12 |
| **Phosphorus (Colwell)** | mg/kg | 48 | 10 | 10 | 57 | 5 | 11 |
| **Phosphorus Buffer Index (PBI-Col)** | | 78 | 110 | 86 | 120 | 98 | 79 |
| **Available Potassium** | mg/kg | 570 | 640 | 540 | 500 | 600 | 520 |
| **Sulphur (KCl40)** | mg/kg | 14 | 7 | 10 | 15 | 13 | 16 |
| **Organic Carbon (W&B)** | % | 1.3 | 0.2 | 0.2 | 0.9 | 0.2 | <0.2 |
| **pH (1:5 Water)** | | 5.8 | 8.5 | 8.8 | 6.4 | 8.5 | 9.1 |
| **pH (1:5 CaCl2)** | | 5.1 | 7.9 | 8.2 | 5.5 | 7.7 | 8.3 |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Electrical Conductivity (1:5 water)** | dS/m | 0.14 | 0.19 | 0.19 | 0.11 | 0.22 | 0.22 |
| **Elec. Cond. (Sat. Ext.)** | dS/m | 0.9 | 1.2 | 1.2 | 0.7 | 1.4 | 1.4 |
| **Chloride** | mg/kg | 15 | <10 | <10 | 15 | <10 | 12 |
| **Calcium (Amm-acet.)** | cmol(+)/kg | 6.1 | 16.0 | 18.0 | 5.6 | 11.0 | 11.0 |
| **Potassium (Amm-acet.)** | cmol(+)/kg | 1.5 | 1.6 | 1.4 | 1.3 | 1.5 | 1.3 |
| **Magnesium (Amm-acet.)** | cmol(+)/kg | 4.0 | 9.6 | 11.0 | 4.5 | 9.1 | 10.0 |
| **Sodium (Amm-acet.)** | cmol(+)/kg | 0.1 | 0.4 | 0.6 | 0.5 | 1.1 | 1.6 |
| **Aluminium (KCl)** | cmol(+)/kg | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **Cation Exch. Cap.** | cmol(+)/kg | 11.7 | 27.3 | 30.6 | 11.8 | 23.2 | 24.2 |
| **Calcium/Magnesium Ratio** | | 1.5 | 1.7 | 1.6 | 1.2 | 1.2 | 1.1 |
| **Sodium % of Cations (ESP)** | % | 1.1 | 1.3 | 1.9 | 4.1 | 4.8 | 6.8 |
| **Aluminium Saturation** | % | <1.0 | 0.4 | <1.0 | <1.0 | <1.0 | <1.0 |
| **Aluminium (KCl)** | mg/kg | <9.0 | 9.1 | <9.0 | <9.0 | <9.0 | <9.0 |
| **Calcium (Amm-acet.)** | % | 52 | 57 | 59 | 47 | 49 | 44 |
| **Magnesium (Amm-acet.)** | % | 34 | 35 | 35 | 38 | 39 | 43 |
| **Potassium (Amm-acet.)** | % | 12 | 6 | 4.5 | 11 | 6.6 | 5.5 |
| **Phosphorus Environmental Risk Index** | | 0.62 | 0.09 | 0.12 | 0.48 | 0.05 | 0.14 |
| **Copper (DTPA)** | mg/kg | 1.00 | 1.00 | 0.75 | 1.50 | 1.00 | 0.89 |
| **Iron (DTPA)** | mg/kg | 87 | 9.1 | 9.3 | 170 | 18 | 11 |
| **Manganese (DTPA)** | mg/kg | 29 | 2.1 | 1.4 | 26 | 6.1 | 2.1 |
| **Zinc (DTPA)** | mg/kg | 2.80 | 0.32 | 0.69 | 1.70 | 0.41 | 0.48 |
| **Boron (Hot CaCl2)** | mg/kg | 1.5 | 2.7 | 4.2 | 1.5 | 3.1 | 5.4 |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 2**. Chickpea.

| Paddock Name | | Overhead | | |
|---|---|---|---|---|
| Sampling Date | | 12/05/2020 | | |
| Sample Depth | | 0-30 cm | 30-60 cm | 60-90 cm |
| Soil Colour | | Brown | Orange/ Yellow | Orange/ Yellow |
| Soil Texture | | Clay | Clay | Clay |
| Nitrate Nitrogen | mg/kg | 16 | 9.9 | 5 |
| Ammonium Nitrogen | mg/kg | 1.2 | 0.9 | <0.6 |
| Nitrate Nitrogen | kg/ha | 62 | 39 | 20 |
| Ammonium Nitrogen | kg/ha | 5 | 4 | |
| Total N | kg/ha | 67 | 42 | 20 |
| Phosphorus (Colwell) | mg/kg | 40 | 14 | 9 |
| Phosphorus Buffer Index (PBI-Col) | | 130 | 120 | 81 |
| Available Potassium | mg/kg | 520 | 410 | 360 |
| Sulphur (KCl40) | mg/kg | 12 | 13 | 13 |
| Organic Carbon (W&B) | % | 1 | 0.3 | <0.2 |
| pH (1:5 Water) | | 6.8 | 8.3 | 9.3 |
| pH (1:5 CaCl2) | | 5.8 | 7.7 | 8.5 |
| Electrical Conductivity (1:5 water) | dS/m | 0.1 | 0.24 | 0.25 |
| Elec. Cond. (Sat. Ext.) | dS/m | 0.6 | 1.5 | 1.6 |
| Chloride | mg/kg | 14 | <10 | <10 |
| Calcium (Amm-acet.) | cmol(+)/kg | 5.9 | 10.0 | 12.0 |
| Potassium (Amm-acet.) | cmol(+)/kg | 1.3 | 1.1 | 0.9 |
| Magnesium (Amm-acet.) | cmol(+)/kg | 6.9 | 11.0 | 12.0 |
| Sodium (Amm-acet.) | cmol(+)/kg | 0.6 | 1.0 | 2.0 |
| Aluminium (KCl) | cmol(+)/kg | <0.1 | 0.1 | <0.1 |
| Cation Exch. Cap. | cmol(+)/kg | 14.6 | 23.5 | 26.8 |
| Calcium/Magnesium Ratio | | 0.9 | 0.9 | 1.0 |
| Sodium % of Cations (ESP) | % | 3.7 | 4.4 | 7.5 |
| Aluminium Saturation | % | <1.0 | 0.4 | <1.0 |
| Aluminium (KCl) | mg/kg | <9.0 | 9.1 | <9.0 |
| Calcium (Amm-acet.) | % | 40 | 44 | 44 |
| Magnesium (Amm-acet.) | % | 47 | 47 | 44 |
| Potassium (Amm-acet.) | % | 9.1 | 4.5 | 3.4 |
| Phosphorus Environmental Risk Index | | 0.31 | 0.12 | 0.12 |
| Copper (DTPA) | mg/kg | 1.50 | 1.00 | 0.48 |
| Iron (DTPA) | mg/kg | 140 | 30 | 7.7 |
| Manganese (DTPA) | mg/kg | 15 | 4.1 | 0.8 |
| Zinc (DTPA) | mg/kg | 0.76 | 0.30 | 0.16 |
| Boron (Hot CaCl2) | mg/kg | 2.6 | 3.9 | 6.7 |

**Table 3**. Durum.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

| Paddock Name | | Flood - Trial 2 | | | Overhead - Trial 1, 5 & 6 | | | Overhead - Trial 3, 4 & 7 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 12/05/2020 | | | 12/05/2020 | | | 12/05/2020 | | |
| Sample Depth | | 0-30 cm | 30-60 cm | 60-90 cm | 0-30 cm | 30-60 cm | 60-90 cm | 0-30 cm | 30-60 cm | 60-90 cm |
| Soil Colour | | Brown | Orange/ Yellow | Orange/ Yellow | Orange/ Yellow | Orange/ Yellow | Orange/ Yellow | Brown | Orange/ Yellow | Orange/ Yellow |
| Soil Texture | | Clay | Clay | Clay | Clay | Clay | Clay | Clay | Clay | Clay |
| Nitrate Nitrogen | mg/kg | 38 | 13 | 5.9 | 25 | 19 | 12 | 29 | 16 | 13 |
| Ammonium Nitrogen | mg/kg | 1.5 | 0.7 | <0.6 | 1 | 0.8 | <0.6 | 1.2 | <0.6 | 0.8 |
| Nitrate Nitrogen | kg/ha | 148 | 51 | 23 | 98 | 74 | 47 | 113 | 62 | 51 |
| Ammonium Nitrogen | kg/ha | 6 | 3 | | 4 | 3 | | 5 | | 3 |
| Total N | kg/ha | 154 | 53 | 23 | 101 | 77 | 47 | 118 | 62 | 54 |
| Phosphorus (Colwell) | mg/kg | 45 | <5 | 9 | 31 | 8 | <5 | 34 | <5 | 11 |
| Phosphorus Buffer Index (PBI-Col) | | 65 | 110 | 94 | 74 | 92 | 83 | 78 | 110 | 95 |
| Available Potassium | mg/kg | 430 | 470 | 400 | 280 | 320 | 300 | 490 | 550 | 420 |
| Sulphur (KCl40) | mg/kg | 13 | 13 | 30 | 10 | 15 | 32 | 12 | 8 | 11 |
| Organic Carbon (W&B) | % | 1.2 | 0.3 | <0.2 | 0.9 | 0.3 | <0.2 | 1.2 | 0.3 | <0.2 |
| pH (1:5 Water) | | 6.2 | 8.8 | 9.4 | 6.6 | 8.8 | 9.3 | 6 | 8.4 | 9.1 |
| pH (1:5 CaCl2) | | 5.4 | 7.9 | 8.5 | 5.6 | 7.9 | 8.5 | 5.2 | 7.8 | 8.3 |
| Electrical Conductivity (1:5 water) | dS/m | 0.13 | 0.22 | 0.32 | 0.1 | 0.24 | 0.31 | 0.11 | 0.22 | 0.25 |
| Elec. Cond. (Sat. Ext.) | dS/m | 0.8 | 1.4 | 2.0 | 0.6 | 1.5 | 1.9 | 0.7 | 1.4 | 1.6 |
| Chloride | mg/kg | 24 | 25 | 57 | 11 | 26 | 34 | <10 | <10 | <10 |
| Calcium (Amm-acet.) | cmol(+)/kg | 4.6 | 6.9 | 14.0 | 4.7 | 6.5 | 14.0 | 5.8 | 11.0 | 19.0 |
| Potassium (Amm-acet.) | cmol(+)/kg | 1.1 | 1.2 | 1.0 | 0.7 | 0.8 | 0.8 | 1.3 | 1.4 | 1.1 |
| Magnesium (Amm-acet.) | cmol(+)/kg | 4.2 | 11.0 | 11.0 | 5.8 | 13.0 | 13.0 | 4.8 | 12.0 | 14.0 |
| Sodium (Amm-acet.) | cmol(+)/kg | 0.6 | 2.0 | 2.5 | 0.7 | 2.5 | 2.8 | 0.2 | 0.7 | 1.3 |
| Aluminium (KCl) | cmol(+)/kg | 0.1 | <0.1 | <0.1 | 0.1 | <0.1 | <0.1 | 0.1 | 0.1 | 0.1 |
| Cation Exch. Cap. | cmol(+)/kg | 10.5 | 21.5 | 29.2 | 12.1 | 23.1 | 30.5 | 12.2 | 25.3 | 35.1 |
| Calcium/Magnesium Ratio | | 1.1 | 0.6 | 1.3 | 0.8 | 0.5 | 1.1 | 1.2 | 0.9 | 1.4 |
| Sodium % of Cations (ESP) | % | 5.2 | 9.4 | 8.7 | 6.1 | 11.0 | 9.1 | 1.8 | 2.8 | 3.8 |
| Aluminium Saturation | % | 1.0 | <1.0 | <1.0 | 0.9 | <1.0 | <1.0 | 0.9 | 0.4 | 0.3 |
| Aluminium (KCl) | mg/kg | 9.8 | <9.0 | <9.0 | 10 | <9.0 | <9.0 | 9.7 | 9.1 | 10 |
| Calcium (Amm-acet.) | % | 44 | 32 | 49 | 39 | 28 | 45 | 48 | 45 | 54 |
| Magnesium (Amm-acet.) | % | 40 | 53 | 39 | 48 | 58 | 43 | 40 | 46 | 39 |
| Potassium (Amm-acet.) | % | 11 | 5.6 | 3.5 | 5.8 | 3.5 | 2.5 | 10 | 5.6 | 3.1 |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Phosphorus Environmental Risk Index** | | 0.69 | 0.05 | 0.09 | 0.42 | 0.09 | 0.06 | 0.44 | 0.05 | 0.12 |
| **Copper (DTPA)** | mg/kg | 0.98 | 0.91 | 0.62 | 0.91 | 0.87 | 0.53 | 1.10 | 1.00 | 0.78 |
| **Iron (DTPA)** | mg/kg | 96 | 12 | 7.8 | 73 | 14 | 6.7 | 110 | 11 | 8.5 |
| **Manganese (DTPA)** | mg/kg | 22 | 2.8 | 1.2 | 14 | 2.5 | 0.8 | 15 | 2.8 | 0.9 |
| **Zinc (DTPA)** | mg/kg | 3.70 | 0.18 | 0.11 | 1.40 | 0.28 | 0.10 | 1.00 | 0.88 | 0.51 |
| **Boron (Hot CaCl2)** | mg/kg | 1.8 | 5.0 | 7.2 | 2.0 | 6.5 | 8.8 | 2.0 | 3.5 | 6.8 |

**Table 4**. Canola.

| Paddock Name | | Flood - Trial 2 | | | Overhead Trial 1 & 5 | | | Overhead Trial 3, 4 & 6 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sampling Date** | | 12/05/2020 | | | 12/05/2020 | | | 12/05/2020 | | |
| **Sample Depth** | | 0-30 cm | 30-60 cm | 60-90 cm | 0-30 cm | 30-60 cm | 60-90 cm | 0-30 cm | 30-60 cm | 60-90 cm |
| **Soil Colour** | | Brown | Orange/ Yellow | Orange/ Yellow | Brown | Brown | Orange/ Yellow | Brown | Orange/ Yellow | Orange/ Yellow |
| **Soil Texture** | | Clay | Clay | Clay | Clay | Clay | Clay | Clay | Clay | Clay |
| **Nitrate Nitrogen** | mg/kg | 38 | 8.9 | 5.2 | 19 | 4.3 | 2.4 | 16 | 9.9 | 5 |
| **Ammonium Nitrogen** | mg/kg | 2.7 | <0.6 | <0.6 | 5.9 | <0.6 | 0.8 | 1.2 | 0.9 | <0.6 |
| **Nitrate Nitrogen** | kg/ha | 148 | 35 | 20 | 74 | 17 | 9 | 62 | 39 | 20 |
| **Ammonium Nitrogen** | kg/ha | 11 | | | 23 | | 3 | 5 | 4 | |
| **Total N** | kg/ha | 159 | 35 | 20 | 97 | 17 | 12 | 67 | 42 | 20 |
| **Phosphorus (Colwell)** | mg/kg | 48 | <5 | <5 | 57 | 5 | 11 | 40 | 14 | 9 |
| **Phosphorus Buffer Index (PBI-Col)** | | | 89 | 98 | 90 | 120 | 98 | 79 | 130 | 120 |
| **Available Potassium** | mg/kg | 440 | 490 | 430 | 500 | 600 | 520 | 520 | 410 | 360 |
| **Sulphur (KCl40)** | mg/kg | 11 | 5 | 13 | 15 | 13 | 16 | 12 | 13 | 13 |
| **Organic Carbon (W&B)** | % | 1.2 | 0.2 | <0.2 | 0.9 | 0.2 | <0.2 | 1 | 0.3 | <0.2 |
| **pH (1:5 Water)** | | 5.9 | 8.9 | 9.2 | 6.4 | 8.5 | 9.1 | 6.8 | 8.3 | 9.3 |
| **pH (1:5 CaCl2)** | | 5 | 8 | 8.4 | 5.5 | 7.7 | 8.3 | 5.8 | 7.7 | 8.5 |
| **Electrical Conductivity (1:5 water)** | dS/m | 0.12 | 0.19 | 0.26 | 0.11 | 0.22 | 0.22 | 0.1 | 0.24 | 0.25 |
| **Elec. Cond. (Sat. Ext.)** | dS/m | 0.7 | 1.2 | 1.6 | 0.7 | 1.4 | 1.4 | 0.6 | 1.5 | 1.6 |
| **Chloride** | mg/kg | 17 | <10 | 11 | 15 | <10 | 12 | 14 | <10 | <10 |
| **Calcium (Amm-acet.)** | cmol(+)/kg | 4.9 | 9.6 | 15.0 | 5.6 | 11.0 | 11.0 | 5.9 | 10.0 | 12.0 |
| **Potassium (Amm-acet.)** | cmol(+)/kg | 1.1 | 1.3 | 1.1 | 1.3 | 1.5 | 1.3 | 1.3 | 1.1 | 0.9 |
| **Magnesium (Amm-acet.)** | cmol(+)/kg | 4.2 | 11.0 | 12.0 | 4.5 | 9.1 | 10.0 | 6.9 | 11.0 | 12.0 |
| **Sodium (Amm-acet.)** | cmol(+)/kg | 0.4 | 1.4 | 1.8 | 0.5 | 1.1 | 1.6 | 0.6 | 1.0 | 2.0 |
| **Aluminium (KCl)** | cmol(+)/kg | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.1 | <0.1 |
| **Cation Exch. Cap.** | cmol(+)/kg | 10.8 | 23.4 | 29.4 | 11.8 | 23.2 | 24.2 | 14.6 | 23.5 | 26.8 |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Calcium/Magnesium Ratio** | | 1.2 | 0.9 | 1.3 | 1.2 | 1.2 | 1.1 | 0.9 | 0.9 | 1.0 |
| **Sodium % of Cations (ESP)** | % | 3.8 | 6.0 | 6.2 | 4.1 | 4.8 | 6.8 | 3.7 | 4.4 | 7.5 |
| **Aluminium Saturation** | % | 1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | 0.4 | <1.0 |
| **Aluminium (KCl)** | mg/kg | 9.6 | <9.0 | <9.0 | <9.0 | <9.0 | <9.0 | <9.0 | 9.1 | <9.0 |
| **Calcium (Amm-acet.)** | % | 45 | 41 | 50 | 47 | 49 | 44 | 40 | 44 | 44 |
| **Magnesium (Amm-acet.)** | % | 39 | 48 | 40 | 38 | 39 | 43 | 47 | 47 | 44 |
| **Potassium (Amm-acet.)** | % | 10 | 5.4 | 3.8 | 11 | 6.6 | 5.5 | 9.1 | 4.5 | 3.4 |
| **Phosphorus Environmental Risk Index** | | | 0.54 | 0.05 | 0.06 | 0.48 | 0.05 | 0.14 | 0.31 | 0.12 |
| **Copper (DTPA)** | mg/kg | 1.00 | 0.84 | 0.63 | 1.50 | 1.00 | 0.89 | 1.50 | 1.00 | 0.48 |
| **Iron (DTPA)** | mg/kg | 92 | 10 | 9.1 | 170 | 18 | 11 | 140 | 30 | 7.7 |
| **Manganese (DTPA)** | mg/kg | 27 | 2.6 | 1.1 | 26 | 6.1 | 2.1 | 15 | 4.1 | 0.8 |
| **Zinc (DTPA)** | mg/kg | 3.10 | 0.76 | 0.37 | 1.70 | 0.41 | 0.48 | 0.76 | 0.30 | 0.16 |
| **Boron (Hot CaCl2)** | mg/kg | 1.7 | 3.8 | 6.8 | 1.5 | 3.1 | 5.4 | 2.6 | 3.9 | 6.7 |

**Table 5**. Barley.

| **Paddock Name** | | **Barley** | | |
|---|---|---|---|---|
| **Sampling Date** | | 12/05/2020 | | |
| **Sample Depth** | | 0-30 cm | 30-60 cm | 60-90 cm |
| **Soil Colour** | | Brown | Orange/ Yellow | Orange/ Yellow |
| **Soil Texture** | | Clay | Clay | Clay |
| **Nitrate Nitrogen** | mg/kg | 29 | 16 | 13 |
| **Ammonium Nitrogen** | mg/kg | 1.2 | <0.6 | 0.8 |
| **Nitrate Nitrogen** | kg/ha | 113 | 62 | 51 |
| **Ammonium Nitrogen** | kg/ha | 5 | | 3 |
| **Total N** | kg/ha | 118 | 62 | 54 |
| **Phosphorus (Colwell)** | mg/kg | 34 | <5 | 11 |
| **Phosphorus Buffer Index (PBI-Col)** | | 78 | 110 | 95 |
| **Available Potassium** | mg/kg | 490 | 550 | 420 |
| **Sulphur (KCl40)** | mg/kg | 12 | 8 | 11 |
| **Organic Carbon (W&B)** | % | 1.2 | 0.3 | <0.2 |
| **pH (1:5 Water)** | | 6 | 8.4 | 9.1 |
| **pH (1:5 CaCl2)** | | 5.2 | 7.8 | 8.3 |
| **Electrical Conductivity (1:5 water)** | dS/m | 0.11 | 0.22 | 0.25 |
| **Elec. Cond. (Sat. Ext.)** | dS/m | 0.7 | 1.4 | 1.6 |
| **Chloride** | mg/kg | <10 | <10 | <10 |
| **Calcium (Amm-acet.)** | cmol(+)/kg | 5.8 | 11.0 | 19.0 |
| **Potassium (Amm-acet.)** | cmol(+)/kg | 1.3 | 1.4 | 1.1 |
| **Magnesium (Amm-acet.)** | cmol(+)/kg | 4.8 | 12.0 | 14.0 |
| **Sodium (Amm-acet.)** | cmol(+)/kg | 0.2 | 0.7 | 1.3 |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

| | | | | |
|---|---|---|---|---|
| **Aluminium (KCl)** | cmol(+)/kg | 0.1 | 0.1 | 0.1 |
| **Cation Exch. Cap.** | cmol(+)/kg | 12.2 | 25.3 | 35.1 |
| **Calcium/Magnesium Ratio** | | 1.2 | 0.9 | 1.4 |
| **Sodium % of Cations (ESP)** | % | 1.8 | 2.8 | 3.8 |
| **Aluminium Saturation** | % | 0.9 | 0.4 | 0.3 |
| **Aluminium (KCl)** | mg/kg | 9.7 | 9.1 | 10 |
| **Calcium (Amm-acet.)** | % | 48 | 45 | 54 |
| **Magnesium (Amm-acet.)** | % | 40 | 46 | 39 |
| **Potassium (Amm-acet.)** | % | 10 | 5.6 | 3.1 |
| **Phosphorus Environmental Risk Index** | | 0.44 | 0.05 | 0.12 |
| **Copper (DTPA)** | mg/kg | 1.10 | 1.00 | 0.78 |
| **Iron (DTPA)** | mg/kg | 110 | 11 | 8.5 |
| **Manganese (DTPA)** | mg/kg | 15 | 2.8 | 0.9 |
| **Zinc (DTPA)** | mg/kg | 1.00 | 0.88 | 0.51 |
| **Boron (Hot CaCl2)** | mg/kg | 2.0 | 3.5 | 6.8 |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

# Kerang VIC

## Meteorological Data

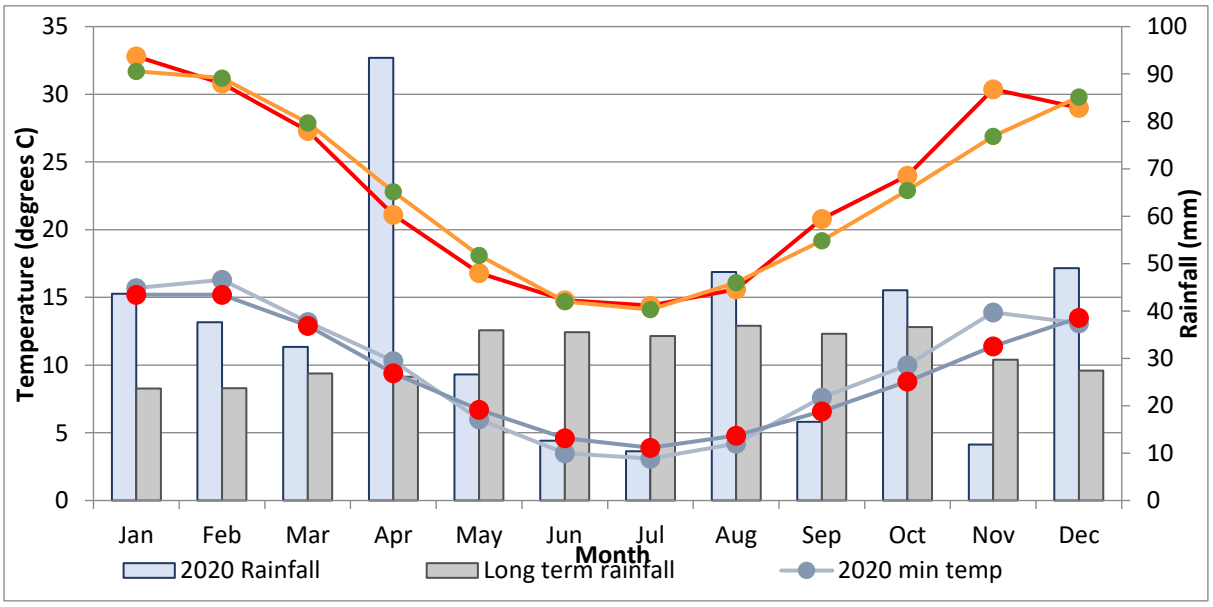


**Figure 1.** 2020 annual rainfall and long-term rainfall (1880-2020) (recorded at Kerang), 2020 min and max temperatures and long-term min and max temperatures (1903-2020) (recorded at Kerang). Rainfall April to October= 252.2mm.

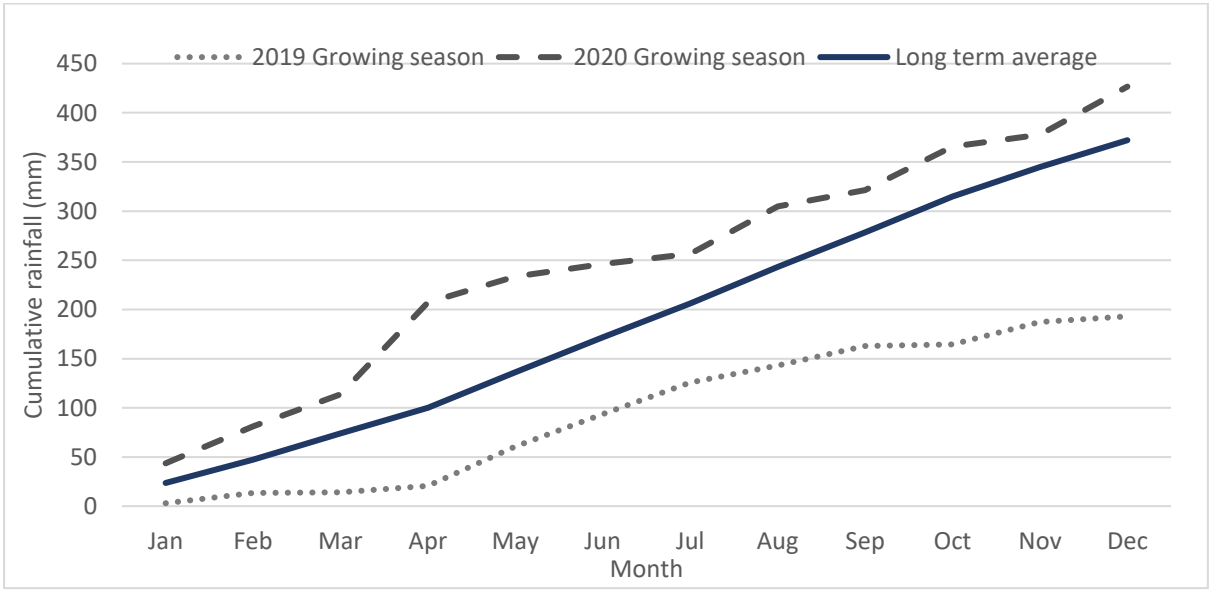


**Figure 2.** Cumulative growing season rainfall (April-November) for 2020, 2019, and the long-term average.



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

## Irrigation Schedule

*Overhead irrigation*

**Table 1.** Faba bean sprinkler irrigation schedule.

| | Irrigation Applied (mm) |
|---|---|
| **Date** | **Trial 1** |
| **1-Sep** | 28 |
| **8-Sep** | 15 |
| **15-Sep** | 30 |
| **29-Sep** | 28 |
| **12-Oct** | 28 |
| **Total** | **129** |

**Table 2.** Durum wheat sprinkler irrigation schedule.

| | Irrigation Applied (mm) |
|---|---|
| **Date** | **Trial 1** |
| **1-Sep** | 25 |
| **4-Sep** | 15 |
| **16-Sep** | 28 |
| **30-Sep** | 28 |
| **1-Oct** | 28 |
| **9-Oct** | 28 |
| **19-Oct** | 28 |
| **7-Nov** | 28 |
| **Total** | **208** |

**Table 3.** Canola sprinkler irrigation schedule.

| | Irrigation Applied (mm) |
|---|---|
| **Date** | **Trial 1** |
| **28-Aug** | 26 |
| **14-Sep** | 26 |
| **24-Sep** | 30 |
| **14-Oct** | 30 |
| **Total** | **112** |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

*Flood irrigation*

**Table 1.** Faba bean flood irrigation schedule.

| | Irrigation Applied (mm) |
|---|---|
| **Date** | **Trial 2, 3 & 4** |
| **9-Apr** | 150 |
| **9-Sep** | 90 |
| **7-Oct** | 90 |
| **Total** | **330** |

**Table 2.** Chickpea flood irrigation schedule.

| | | Irrigation Applied (mm) | |
|---|---|---|---|
| **Date** | **Trial 1** | **Trial 2** | **Trial 3** |
| **9-Apr** | | 150 | |
| **24-Apr** | 150 | | 130 |
| **1-Sep** | | 70 | |
| **7-Sep** | 80 | | 80 |
| **23-Sep** | | 70 | |
| **Total** | **230** | **290** | **210** |

**Table 3.** Durum wheat flood irrigation schedule.

| | | Irrigation Applied (mm) | |
|---|---|---|---|
| **Date** | **Trial 2** | **Trial 3, 4** | **Trial 5, 6 & 7** |
| **9-Apr** | | 150 | |
| **24-Apr** | 150 | | 150 |
| **8-Sep** | | | 80 |
| **9-Sep** | 80 | 80 | |
| **7-Oct** | 100 | 100 | 100 |
| **4-Nov** | 100 | | |
| **6-Nov** | | 100 | |
| **7-Nov** | | | 100 |
| **Total** | **430** | **430** | **430** |

**Table 4.** Canola flood irrigation schedule

| | Irrigation Applied (mm) |
|---|---|
| **Date** | **Trial 2, 3 & 4** |
| **24-Apr** | 130 |
| **9-Sep** | 90 |
| **7-Oct** | 80 |
| **Total** | **300** |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 5.** Barley flood irrigation schedule.

| | Irrigation Applied (mm) |
|---|---|
| **Date** | **Trial 1** |
| **8-Apr** | 150 |
| **17-Aug** | 80 |
| **23-Sep** | 90 |
| **14-Oct** | 80 |
| **Total** | **400** |

**Table 6.** Amelioration trial irrigation flood schedule.

| | Irrigation Applied (mm) |
|---|---|
| **Date** | **Trial 1** |
| **2-Apr** | 150 |
| **13-Oct** | 120 |
| **Total** | **270** |

## Crop Inputs

**Table 1.** Faba bean trial inputs. Unless otherwise indicated by the treatment list in the individual trials the following inputs were applied to the faba bean trials at the Kerang Irrigated Research Centre.

| | | | | |
|---|---|---|---|---|
| **Sowing Date:** | | | 8-May | |
| **Variety:** | | | Variable | |
| **Seed Rate:** | | | 25 plants/m2 | |
| **Sowing Fertiliser:** | | | 250kg Superfect | |
| **Seed Treatment:** | | | Gaucho 600 120ml/100 kg | |
| **Herbicide:** | 7-May | Pre-sow | Glyphosate 540 1.5l/ha | |
| | 29-May | Pre-sow | Goal 75ml/ha | |
| | | Pre-sow | Terrain 180 g/ha | |
| | 1-Jul | Vegetative | Factor 180 g/ha | |
| **Nitrogen:** | | | Nil | |
| **Fungicide:** | 6-Aug | Vegetative | Chlorothalonil 1.5 l/ha | Trials 1&2 |
| | 7-Sep | Early Flowering | Chlorothalonil 1.5 l/ha | Trials 1&2 |
| | 7-Oct | Early podding | Chlorothalonil 1.5 l/ha | Trials 1&2 |
| **PGR:** | | | Nil | |



The GRDC Optimising Irrigated Grains Project is a collaborative project including the following project partners:

**Table 2.** Chickpea trial inputs. Unless otherwise indicated by the treatment list in the individual trials the following inputs were applied to the faba bean trials at the Kerang Irrigated Research Centre.

| | | | | |
|---|---|---|---|---|
| **Sowing Date:** | | | 18-May | |
| **Variety:** | | | Variable | |
| **Seed Rate:** | | | 35 Plants/m2 | |
| **Sowing Fertiliser:** | | | 250kg Superfect | |
| **Seed Treatment:** | | | Nil | |
| **Inoculum:** | | | Alosca granules 10kg/ha | |
| **Herbicide:** | 17-May | Pre-sow | Glyphosate 540 1.5l/ha | Trials 1,3 |
| | 17-May | Pre-sow | Goal 75ml/ha | Trials 1,3 |
| | 17-May | Pre-sow | Terrain 180 g/ha | Trials 1,3 |
| | 10-May | Pre-sow | Glyphosate 540 1.5l/ha | Trial 2 |
| | 10-May | Pre-sow | Goal 75ml/ha | Trial 2 |
| | 10-May | Pre-sow | Terrain 180 g/ha | Trial 2 |
| | 15-Jun | Vegetative | Clethodim 240 500 ml/ha | Trial 2 |
| **Nitrogen:** | | | Nil | |
| **Fungicide:** | 4-Aug | 8 Node | Chlorothalonil 1.5 l/ha | Trial 1 |
| | 6-Sep | Early flowering | Chlorothalonil 1.5 l/ha | Trial 1 |
| | 28-Aug | Early flowering | Chlorothalonil 1.5 l/ha | Trial 2 |
| | 21-Sep | Late flowering | Chlorothalonil 1.5 l/ha | Trial 2 |
| **PGR:** | | | Nil | |

**Table 3.** Durum wheat trial inputs. Unless otherwise indicated by the treatment list in the individual trials the following inputs were applied to the faba bean trials at the Kerang Irrigated Research Centre.

| | | | | |
|---|---|---|---|---|
| **Sowing Date:** | | | 29-May | |
| **Variety:** | | | Variable | |
| **Seed Rate:** | | | 160 plants/m2 | |
| **Sowing Fertiliser:** | | | 125kg DAP | |
| **Seed Treatment:** | | | Vibrance 180 g/100 kg | |
| **Herbicide:** | 7-May | Fallow | Gramoxone 250 2l/ha | |
| | 29-May | Pre-sow | Glyphosate 540 1.5l/ha | |
| | | Pre-sow | Goal 75ml/ha | |
| | | Pre-sow | Boxer Gold 2.5l/ha | |
| | 7-Aug | Tillering | Triathlon 1l/ha | |
| | | | | |
| **Nitrogen:** | 8-Sep | GS32 | 100 kg N/ha | Trials 2,5,6,7 |
| | 18-Sep | GS37 | 100 kg N/ha | Trials 2,5,6,7 |
| | 4-Oct | GS55 | 115 kg N/ha | Trials 2,5,6,7 |
| | 8-Sep | GS32 | 55 kg N/ha | Trial 1 |
| | 18-Sep | GS37 | 100 kg N/ha | Trial 1 |
| | 4-Oct | GS55 | 90 kg N/ha | Trial 1 |
| **Fungicide:** | 26-Sep | GS39 | 0.25 l/ha Tilt Xtra | Trials 1&2 |

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| | | | | |
|---|---|---|---|---|
| | 21-Sep | GS39 | 0.25 l/ha Tilt Xtra | Trial 4 |
| | 4-Oct | GS55 | 0.25 l/ha Tilt Xtra | Trial 7 |
| **PGR:** | 17-Aug | GS31-32 | 0.4 l/ha Moddus Evo | Trial 4 |
| | 4-Sep | GS32 | 0.4 l/ha Moddus Evo | Trials 1,2,5,6 |

**Table 4.** Canola trial inputs. Unless otherwise indicated by the treatment list in the individual trials the following inputs were applied to the faba bean trials at the Kerang Irrigated Research Centre.

| | | | | |
|---|---|---|---|---|
| **Sowing Date:** | | | 23-Apr | |
| **Variety:** | | | Variable | |
| **Seed Rate:** | | | 40 Plants/m2 | |
| **Sowing Fertiliser:** | | | 125kg DAP | |
| **Seed Treatment:** | | | HyTTec® Trophy – (Poncho + Maxim), 45Y28 RR – (Jockey + Poncho | |
| **Herbicide:** | 5-Jun | 4 leaf | Clethodim 240 500 ml/ha | Trials 1,2 |
| | 5-Jun | 4 leaf | Lontrel Adv 125ml/ha | Trials 1,2 |
| | 15-Jun | 5-6 leaf | Roundup Plantshield 900 g/ha | Trials 3,4 |
| **Nitrogen:** | 1-Jul | 8 leaf | 55kg N/ha | Trial 1 |
| | 6-Aug | Green Bud | 40kg N/ha | Trial 1 |
| | 1-Jul | 8 leaf | 55kg N/ha | Trial 2 |
| | 6-Aug | Green Bud | 80kg N/ha | Trial 2 |
| **Fungicide:** | | | Nil | |
| **PGR:** | | | Nil | |

**Table 5.** Barley trial inputs. Unless otherwise indicated by the treatment list in the individual trials the following inputs were applied to the faba bean trials at the Kerang Irrigated Research Centre.

| | | | | |
|---|---|---|---|---|
| **Sowing Date:** | | | 17-Apr | |
| **Variety:** | | | Cassiopee | |
| **Seed Rate:** | | | 160 plants/m2 | |
| **Sowing Fertiliser:** | | | 125kg DAP | |
| **Seed Treatment:** | | | Nil | |
| **Herbicide:** | 16-Apr | Pre-sowing | Glyphosate 540 1.5 l/ha | |
| | 16-Apr | Pre-sowing | Goal 75 ml/ha | |
| | 16-Apr | Pre-sowing | Boxer Gold 2.5 l/ha | |
| | 7-Jul | Tillering | Triathlon 1 l/ha | |
| **Nitrogen:** | 5-Aug | GS30 | Variable | |
| | 11-Sep | GS34 | Variable | |
| **Fungicide:** | | | Nil | |
| **PGR:** | | | Nil | |



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**Table 6.** Amelioration trial inputs. Unless otherwise indicated by the treatment list in the individual trials the following inputs were applied to the faba bean trials at the Kerang Irrigated Research Centre.

| | | | |
|---|---|---|---|
| **Sowing Date:** | | | 24-Apr |
| **Variety:** | | | Wizard Forage Oat |
| **Seed Rate:** | | | 80 kg/ha |
| **Sowing Fertiliser:** | | | 80kg MP |
| **Seed Treatment:** | | | Raxil T 100ml/100kg |
| **Herbicide:** | 24-Apr | Pre-sow | Glyphosate 450 1.5l/ha |
| | 20-Jul | Pre-sow | Tigrex 1 l/ha |
| **Nitrogen:** | 8-Jul | GS15 | 100kg N/ha |
| **Fungicide:** | | | Nil |
| **PGR:** | | | Nil |



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## Soil Test

**Table 1**. Faba bean

| Paddock Name | | Flood – Trials 01-4, 07-2, 09-2 | | | | Overhead Trials, 01-3 | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sampling Date** | | 7/05/2020 | | | | 7/05/2020 | | | |
| **Sample Depth** | | 0-10 cm | 0-30 cm | 30-60 cm | 60-90 cm | 0-10 cm | 0-30 cm | 30-60 cm | 60-90 cm |
| **Soil Colour** | | Grey | | | | Grey | | | |
| **Soil Texture** | | Clay | | Clay | | Clay | | Clay | |
| **Nitrate Nitrogen** | mg/kg | 22 | 22 | 13 | 7 | 25 | 38 | 17 | 5 |
| **Ammonium Nitrogen** | mg/kg | 2 | 6 | 5 | 5 | 2 | 2 | 3 | 3 |
| **Nitrate Nitrogen** | kg/ha | | 86 | 55 | 30 | | 148 | 66 | 21 |
| **Ammonium Nitrogen** | kg/ha | | | | | | | | |
| **Total N** | kg/ha | | | 171 | | | | 236 | |
| **Phosphorus (Colwell)** | mg/kg | 60 | | | | 80 | | | |
| **Phosphorus Buffer Index (PBI-Col)** | | 106 | | | | 102 | | | |
| **Available Potassium** | mg/kg | 548 | | | | 482 | | | |
| **Sulphur (KCl40)** | mg/kg | 18.5 | | | | 16.8 | | | |
| **Organic Carbon (W&B)** | % | 1.05 | | | | 0.81 | | | |
| **pH (1:5 Water)** | | 7.6 | | | | 7.8 | | | |
| **pH (1:5 CaCl2)** | | 6.7 | | | | 6.5 | | | |
| **Electrical Conductivity (1:5 water)** | dS/m | 0.151 | | | | 0.218 | | | |
| **Elec. Cond. (Sat. Ext.)** | dS/m | | | | | | | | |
| **Chloride** | mg/kg | | | | | | | | |
| **Calcium (Amm-acet.)** | cmol(+)/kg | 14.00 | | | | 13.43 | | | |
| **Potassium (Amm-acet.)** | cmol(+)/kg | 1.55 | | | | 1.44 | | | |
| **Magnesium (Amm-acet.)** | cmol(+)/kg | 12.81 | | | | 13.39 | | | |
| **Sodium (Amm-acet.)** | cmol(+)/kg | 2.43 | | | | 2.70 | | | |
| **Aluminium (KCl)** | cmol(+)/kg | 0.05 | | | | 0.06 | | | |
| **Cation Exch. Cap.** | cmol(+)/kg | 30.84 | | | | 31.02 | | | |
| **Calcium/Magnesium Ratio** | | 1.09 | | | | 1.00 | | | |
| **Sodium % of Cations (ESP)** | % | 7.9 | | | | 8.7 | | | |
| **Aluminium Saturation** | % | 0.2 | | | | 0.2 | | | |
| **Aluminium (KCl)** | mg/kg | | | | | | | | |
| **Calcium (Amm-acet.)** | % | | | | | | | | |
| **Magnesium (Amm-acet.)** | % | | | | | | | | |
| **Potassium (Amm-acet.)** | % | | | | | | | | |
| **Phosphorus Environmental Risk Index** | | | | | | | | | |
| **Copper (DTPA)** | mg/kg | 2.22 | | | | 2.54 | | | |



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|---|---|---|---|---|---|---|---|---|---|
| **Iron (DTPA)** | mg/kg | 41.4 | | | | 42.7 | | | |
| **Manganese (DTPA)** | mg/kg | 14.01 | | | | 12.72 | | | |
| **Zinc (DTPA)** | mg/kg | 0.67 | | | | 0.59 | | | |
| **Boron (Hot CaCl2)** | mg/kg | 4.38 | | | | 5.14 | | | |

**Table 2**. Chickpeas

| **Paddock Name** | | **Trials 05-2, 07-2** | | | | **Trial 06-1** | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sampling Date** | | 7/05/2020 | | | | 7/05/2020 | | | |
| **Sample Depth** | | 0-10 cm | 0-30 cm | 30-60 cm | 60-90 cm | 0-10 cm | 0-30 cm | 30-60 cm | 60-90 cm |
| **Soil Colour** | | Grey | | | | Grey Brown | | | |
| **Soil Texture** | | Clay | | Clay | | Clay | | Clay | |
| **Nitrate Nitrogen** | mg/kg | 14 | 18 | 13 | 8 | 10 | 17 | 14 | 12 |
| **Ammonium Nitrogen** | mg/kg | 2 | 9 | 4 | 6 | 8 | 4 | 4 | 3 |
| **Nitrate Nitrogen** | kg/ha | | 66 | 59 | 34 | | 66 | 59 | 50 |
| **Ammonium Nitrogen** | kg/ha | | | | | | | | |
| **Total N** | kg/ha | | | 159 | | | | 175 | |
| **Phosphorus (Colwell)** | mg/kg | 72 | | | | 78 | | | |
| **Phosphorus Buffer Index (PBI-Col)** | | 98 | | | | 90 | | | |
| **Available Potassium** | mg/kg | 491 | | | | 565 | | | |
| **Sulphur (KCl40)** | mg/kg | 10.2 | | | | 6.4 | | | |
| **Organic Carbon (W&B)** | % | 0.98 | | | | 0.92 | | | |
| **pH (1:5 Water)** | | 7.9 | | | | 6.7 | | | |
| **pH (1:5 CaCl2)** | | 6.8 | | | | 5.7 | | | |
| **Electrical Conductivity (1:5 water)** | dS/m | 0.123 | | | | 0.067 | | | |
| **Elec. Cond. (Sat. Ext.)** | dS/m | | | | | | | | |
| **Chloride** | mg/kg | | | | | | | | |
| **Calcium (Amm-acet.)** | cmol(+)/kg | 13.87 | | | | 11.82 | | | |
| **Potassium (Amm-acet.)** | cmol(+)/kg | 1.38 | | | | 1.52 | | | |
| **Magnesium (Amm-acet.)** | cmol(+)/kg | 12.75 | | | | 8.74 | | | |
| **Sodium (Amm-acet.)** | cmol(+)/kg | 2.13 | | | | 0.29 | | | |
| **Aluminium (KCl)** | cmol(+)/kg | 0.07 | | | | 0.09 | | | |
| **Cation Exch. Cap.** | cmol(+)/kg | 30.20 | | | | 22.46 | | | |
| **Calcium/Magnesium Ratio** | | 1.09 | | | | 1.30 | | | |
| **Sodium % of Cations (ESP)** | % | 7.1 | | | | 1.35 | | | |
| **Aluminium Saturation** | % | 0.2 | | | | 0.4 | | | |
| **Aluminium (KCl)** | mg/kg | | | | | | | | |
| **Calcium (Amm-acet.)** | % | | | | | | | | |
| **Magnesium (Amm-acet.)** | % | | | | | | | | |



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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Potassium (Amm-acet.)** | % | | | | | | | | |
| **Phosphorus Environmental Risk Index** | | | | | | | | | |
| **Copper (DTPA)** | mg/kg | 2.19 | | | | 2.46 | | | |
| **Iron (DTPA)** | mg/kg | 43.8 | | | | 91.1 | | | |
| **Manganese (DTPA)** | mg/kg | 11.77 | | | | 24.61 | | | |
| **Zinc (DTPA)** | mg/kg | 0.45 | | | | 2.35 | | | |
| **Boron (Hot CaCl2)** | mg/kg | 3.92 | | | | 1.29 | | | |

**Table 3**. Canola

| **Paddock Name** | | **Trials 01-4, 03-2, 04-2** | | | | **Trial 01-3** | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sampling Date** | | 7/05/2020 | | | | 7/05/2020 | | | |
| **Sample Depth** | | 0-10 cm | 0-30 cm | 30-60 cm | 60-90 cm | 0-10 cm | 0-30 cm | 30-60 cm | 60-90 cm |
| **Soil Colour** | | Grey | | | | Grey | | | |
| **Soil Texture** | | Clay | | Clay | | Clay | | Clay | |
| **Nitrate Nitrogen** | mg/kg | 11 | 17 | 22 | 19 | 25 | 38 | 17 | 5 |
| **Ammonium Nitrogen** | mg/kg | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| **Nitrate Nitrogen** | kg/ha | | 66 | 92 | 80 | | 148 | 66 | 21 |
| **Ammonium Nitrogen** | kg/ha | | | | | | | | |
| **Total N** | kg/ha | | | 238 | | | | 236 | |
| **Phosphorus (Colwell)** | mg/kg | 66 | | | | 93 | | | |
| **Phosphorus Buffer Index (PBI-Col)** | | 105 | | | | 102 | | | |
| **Available Potassium** | mg/kg | 462 | | | | 527 | | | |
| **Sulphur (KCl40)** | mg/kg | 13.1 | | | | 15.2 | | | |
| **Organic Carbon (W&B)** | % | 1.00 | | | | 1.11 | | | |
| **pH (1:5 Water)** | | | | | | | | | |
| **pH (1:5 CaCl2)** | | | | | | | | | |
| **Electrical Conductivity (1:5 water)** | dS/m | 0.097 | | | | 0.113 | | | |
| **Elec. Cond. (Sat. Ext.)** | dS/m | | | | | | | | |
| **Chloride** | mg/kg | | | | | | | | |
| **Calcium (Amm-acet.)** | cmol(+)/kg | 14.68 | | | | 14.73 | | | |
| **Potassium (Amm-acet.)** | cmol(+)/kg | 1.38 | | | | 1.50 | | | |
| **Magnesium (Amm-acet.)** | cmol(+)/kg | 10.76 | | | | 10.37 | | | |
| **Sodium (Amm-acet.)** | cmol(+)/kg | 1.12 | | | | 1.49 | | | |
| **Aluminium (KCl)** | cmol(+)/kg | 0.06 | | | | 0.06 | | | |
| **Cation Exch. Cap.** | cmol(+)/kg | 27.99 | | | | 28.15 | | | |
| **Calcium/Magnesium Ratio** | | 1.36 | | | | 1.42 | | | |
| **Sodium % of Cations (ESP)** | % | 4.0 | | | | 5.3 | | | |



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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Aluminium Saturation** | % | 0.2 | | | | 0.2 | | | |
| **Aluminium (KCl)** | mg/kg | | | | | | | | |
| **Calcium (Amm-acet.)** | % | | | | | | | | |
| **Magnesium (Amm-acet.)** | % | | | | | | | | |
| **Potassium (Amm-acet.)** | % | | | | | | | | |
| **Phosphorus Environmental Risk Index** | | | | | | | | | |
| **Copper (DTPA)** | mg/kg | 2.18 | | | | 2.20 | | | |
| **Iron (DTPA)** | mg/kg | 45.7 | | | | 44.8 | | | |
| **Manganese (DTPA)** | mg/kg | 19.85 | | | | 16.27 | | | |
| **Zinc (DTPA)** | mg/kg | 0.51 | | | | 0.57 | | | |
| **Boron (Hot CaCl2)** | mg/kg | 3.11 | | | | 3.47 | | | |

**Table 4** Durum Wheat

| **Paddock Name** | | **Trials 01-4, 03-2, 04-2 07-2, 08-2, 09-2** | | | | **Trial 01-3** | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sampling Date** | | 7/05/2020 | | | | 7/05/2020 | | | |
| **Sample Depth** | | 0-10 cm | 0-30 cm | 30-60 cm | 60-90 cm | 0-10 cm | 0-30 cm | 30-60 cm | 60-90 cm |
| **Soil Colour** | | Grey | | | | Grey | | | |
| **Soil Texture** | | Clay | | Clay | | Clay | | Clay | |
| **Nitrate Nitrogen** | mg/kg | 18 | 18 | 14 | 9 | 27 | 38 | 12 | 7 |
| **Ammonium Nitrogen** | mg/kg | 5 | 12 | 9 | 10 | 5 | 8 | 7 | 6 |
| **Nitrate Nitrogen** | kg/ha | | 70 | 60 | 38 | | 148 | 50 | 30 |
| **Ammonium Nitrogen** | kg/ha | | | 168 | | | | 228 | |
| **Total N** | kg/ha | | | | | | | | |
| **Phosphorus (Colwell)** | mg/kg | 58 | | | | 67 | | | |
| **Phosphorus Buffer Index (PBI-Col)** | | 112 | | | | 97 | | | |
| **Available Potassium** | mg/kg | 470 | | | | 520 | | | |
| **Sulphur (KCl40)** | mg/kg | 15.7 | | | | 43.1 | | | |
| **Organic Carbon (W&B)** | % | 1.27 | | | | 1.39 | | | |
| **pH (1:5 Water)** | | 7.5 | | | | 7.7 | | | |
| **pH (1:5 CaCl2)** | | 6.7 | | | | 6.9 | | | |
| **Electrical Conductivity (1:5 water)** | dS/m | 0.136 | | | | 0.214 | | | |
| **Elec. Cond. (Sat. Ext.)** | dS/m | | | | | | | | |
| **Chloride** | mg/kg | | | | | | | | |
| **Calcium (Amm-acet.)** | cmol(+)/kg | 14.32 | | | | 15.19 | | | |
| **Potassium (Amm-acet.)** | cmol(+)/kg | 1.26 | | | | 1.32 | | | |
| **Magnesium (Amm-acet.)** | cmol(+)/kg | 11.32 | | | | 9.95 | | | |
| **Sodium (Amm-acet.)** | cmol(+)/kg | 1.75 | | | | 2.74 | | | |



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| | | | |
|---|---|---|---|
| **Aluminium (KCl)** | cmol(+)/kg | 0.70 | 0.04 |
| **Cation Exch. Cap.** | cmol(+)/kg | 28.72 | 29.24 |
| **Calcium/Magnesium Ratio** | | 1.27 | 1.53 |
| **Sodium % of Cations (ESP)** | % | 6.1 | 9.4 |
| **Aluminium Saturation** | % | 0.2 | 0.1 |
| **Aluminium (KCl)** | mg/kg | | |
| **Calcium (Amm-acet.)** | % | | |
| **Magnesium (Amm-acet.)** | % | | |
| **Potassium (Amm-acet.)** | % | | |
| **Phosphorus Environmental Risk Index** | | | |
| **Copper (DTPA)** | mg/kg | 2.83 | 2.73 |
| **Iron (DTPA)** | mg/kg | 48.1 | 47.2 |
| **Manganese (DTPA)** | mg/kg | 15.59 | 14.75 |
| **Zinc (DTPA)** | mg/kg | 1.35 | 1.55 |
| **Boron (Hot CaCl2)** | mg/kg | 2.95 | 4.37 |

**Table 5** Barley

| **Paddock Name** | | **Trial B20-01-2** | | | |
|---|---|---|---|---|---|
| **Sampling Date** | | 7/05/2020 | | | |
| **Sample Depth** | | 0-10 cm | 0-30 cm | 30-60 cm | 60-90 cm |
| **Soil Colour** | | Grey Brown | | | |
| **Soil Texture** | | Clay | | Clay | |
| **Nitrate Nitrogen** | mg/kg | 15 | 9 | 6 | 11 |
| **Ammonium Nitrogen** | mg/kg | 2 | 3 | 3 | 8 |
| **Nitrate Nitrogen** | kg/ha | | 59 | 38 | 25 |
| **Ammonium Nitrogen** | kg/ha | | | | |
| **Total N** | kg/ha | | | 122 | |
| **Phosphorus (Colwell)** | mg/kg | 34 | | | |
| **Phosphorus Buffer Index (PBI-Col)** | | 115 | | | |
| **Available Potassium** | mg/kg | 569 | | | |
| **Sulphur (KCl40)** | mg/kg | 11.5 | | | |
| **Organic Carbon (W&B)** | % | 1.21 | | | |
| **pH (1:5 Water)** | | 7.8 | | | |
| **pH (1:5 CaCl2)** | | 7.2 | | | |
| **Electrical Conductivity (1:5 water)** | dS/m | 0.137 | | | |
| **Elec. Cond. (Sat. Ext.)** | dS/m | | | | |
| **Chloride** | mg/kg | | | | |



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| | | |
|---|---|---|
| **Calcium (Amm-acet.)** | cmol(+)/kg | 14.32 |
| **Potassium (Amm-acet.)** | cmol(+)/kg | 1.57 |
| **Magnesium (Amm-acet.)** | cmol(+)/kg | 8.5 |
| **Sodium (Amm-acet.)** | cmol(+)/kg | 0.5 |
| **Aluminium (KCl)** | cmol(+)/kg | 0.05 |
| **Cation Exch. Cap.** | cmol(+)/kg | 24.94 |
| **Calcium/Magnesium Ratio** | | 1.68 |
| **Sodium % of Cations (ESP)** | % | 2.0 |
| **Aluminium Saturation** | % | 0.2 |
| **Aluminium (KCl)** | mg/kg | |
| **Calcium (Amm-acet.)** | % | |
| **Magnesium (Amm-acet.)** | % | |
| **Potassium (Amm-acet.)** | % | |
| **Phosphorus Environmental Risk Index** | | |
| **Copper (DTPA)** | mg/kg | 2.01 |
| **Iron (DTPA)** | mg/kg | 29.8 |
| **Manganese (DTPA)** | mg/kg | 8.80 |
| **Zinc (DTPA)** | mg/kg | 0.45 |
| **Boron (Hot CaCl2)** | mg/kg | 3.16 |

**Table 6** Amelioration

| **Paddock Name** | | **Trial O20-06a-1** | | | |
|---|---|---|---|---|---|
| **Sampling Date** | | 7/05/2020 | | | |
| **Sample Depth** | | 0-10 cm | 0-30 cm | 30-60 cm | 60-90 cm |
| **Soil Colour** | | Grey | | | |
| **Soil Texture** | | Clay | | Clay | |
| **Nitrate Nitrogen** | mg/kg | 5 | 2 | 1 | 2 |
| **Ammonium Nitrogen** | mg/kg | 4 | 4 | 4 | 4 |
| **Nitrate Nitrogen** | kg/ha | | 8 | 4 | 8 |
| **Ammonium Nitrogen** | kg/ha | | | | |
| **Total N** | kg/ha | | | 20 | |
| **Phosphorus (Colwell)** | mg/kg | 36 | | | |
| **Phosphorus Buffer Index (PBI-Col)** | | 121 | | | |
| **Available Potassium** | mg/kg | 296 | | | |
| **Sulphur (KCl40)** | mg/kg | 9.3 | | | |
| **Organic Carbon (W&B)** | % | 1.01 | | | |
| **pH (1:5 Water)** | | 6.8 | | | |
| **pH (1:5 CaCl2)** | | 5.5 | | | |



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| | | |
|---|---|---|
| **Electrical Conductivity (1:5 water)** | dS/m | 0.081 |
| **Elec. Cond. (Sat. Ext.)** | dS/m | |
| **Chloride** | mg/kg | |
| **Calcium (Amm-acet.)** | cmol(+)/kg | 6.91 |
| **Potassium (Amm-acet.)** | cmol(+)/kg | 0.75 |
| **Magnesium (Amm-acet.)** | cmol(+)/kg | 8.11 |
| **Sodium (Amm-acet.)** | cmol(+)/kg | 1.87 |
| **Aluminium (KCl)** | cmol(+)/kg | 0.06 |
| **Cation Exch. Cap.** | cmol(+)/kg | 17.70 |
| **Calcium/Magnesium Ratio** | | 0.85 |
| **Sodium % of Cations (ESP)** | % | 10.6 |
| **Aluminium Saturation** | % | 0.3 |
| **Aluminium (KCl)** | mg/kg | |
| **Calcium (Amm-acet.)** | % | |
| **Magnesium (Amm-acet.)** | % | |
| **Potassium (Amm-acet.)** | % | |
| **Phosphorus Environmental Risk Index** | | |
| **Copper (DTPA)** | mg/kg | 4.64 |
| **Iron (DTPA)** | mg/kg | 141.1 |
| **Manganese (DTPA)** | mg/kg | 20.46 |
| **Zinc (DTPA)** | mg/kg | 1.14 |
| **Boron (Hot CaCl2)** | mg/kg | 1.54 |



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# Griffith NSW

## Meteorological Data

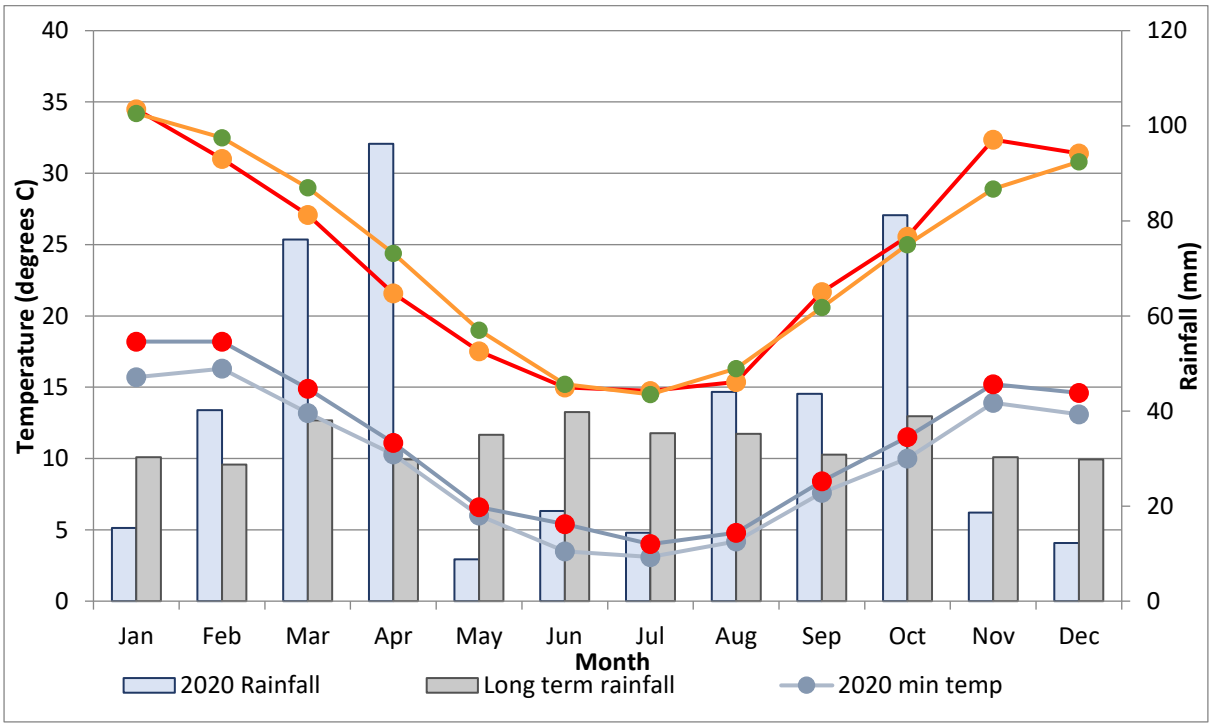


**Figure 1.** 2020 annual rainfall and long-term rainfall (1886-2020) (recorded at Whitton), 2020 min and max temperatures and long-term min and max temperatures (2000-2020) (recorded at Yanco). Rainfall April to October= 252.2mm.

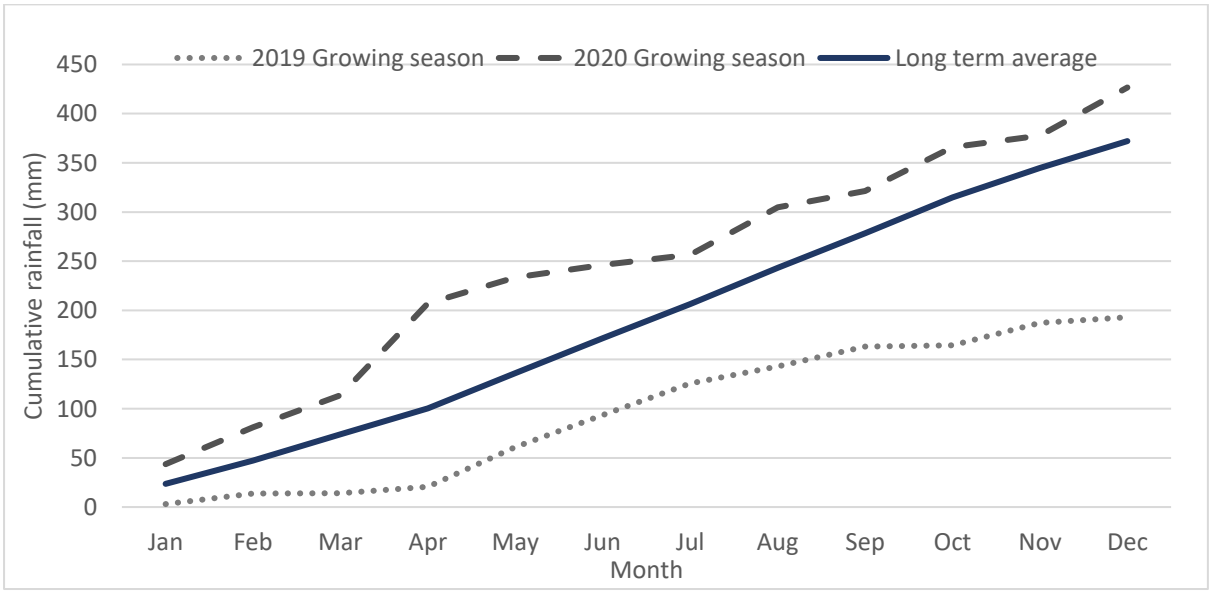


**Figure 2.** Cumulative growing season rainfall (April-November) for 2020, 2019, and the long-term average.



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## Irrigation Schedule

The trial was planned to be irrigated but well-above average April rainfall (106mm) on the back of a summer crop and predictions of a wetter season discouraged the co-operator from pre-irrigation. He decided the spring rainfall was sufficient, therefore unnecessary for any spring irrigation.

## Crop Inputs

**Table 1.** Chickpea trial inputs. Unless otherwise indicated by the treatment list in the individual trials the following inputs were applied to the faba bean trials at the Griffith Irrigated Research Centre.

| | | | |
|---|---|---|---|
| **Sowing Date** | | | 28-May |
| **Variety** | | | Variable |
| **Seed Rate** | | | 35 Plants/m2 |
| **Sowing Fertiliser** | | | 250kg Superfect |
| **Seed Treatment** | | | Nil |
| **Inoculum** | | | Alosca granules 10kg/ha |
| **Herbicide** | 27-May | Pre-sow | Glyphosate 450 1.8l/ha |
| | 15-Jul | Vegetative | Select Xtra 300 ml/ha |
| **Nitrogen** | | | Nil |
| **Fungicide** | 15-Jul | Vegetative | Mancozeb 1 kg/ha |
| | 6-Aug | 6 Node | Chlorothalonil 1.5 l/ha |
| | 17-Sep | Pre-flowering | Chlorothalonil 1.5 l/ha |
| **PGR** | | | Nil |

## Soil Tests

**Table 1** Chickpeas - Griffith

| **Paddock Name** | | **Trials CP20-05-2, 07-3** | | |
|---|---|---|---|---|
| **Sampling Date** | | 28/05/2020 | | |
| **Sample Depth** | | 0-10 cm | 0-30 cm | 30-60 cm |
| **Soil Colour** | | Grey Brown | | |
| **Soil Texture** | | Clay | | Clay |
| **Nitrate Nitrogen** | mg/kg | 16 | 11 | 10 |
| **Ammonium Nitrogen** | mg/kg | 3 | 8 | 7 |
| **Nitrate Nitrogen** | kg/ha | | 43 | 42 |
| **Ammonium Nitrogen** | kg/ha | | | |
| **Total N** | kg/ha | | | 85 |
| **Phosphorus (Colwell)** | mg/kg | 82 | | |
| **Phosphorus Buffer Index (PBI-Col)** | | | | |
| **Available Potassium** | mg/kg | 488 | | |
| **Sulphur (KCl40)** | mg/kg | 22.6 | | |
| **Organic Carbon (W&B)** | % | 1.10 | | |
| **pH (1:5 Water)** | | 7.2 | | |
| **pH (1:5 CaCl2)** | | 6.2 | | |



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| | | |
|---|---|---|
| **Electrical Conductivity (1:5 water)** | dS/m | 0.142 |
| **Elec. Cond. (Sat. Ext.)** | dS/m | |
| **Chloride** | mg/kg | |
| **Calcium (Amm-acet.)** | cmol(+)/kg | 9.53 |
| **Potassium (Amm-acet.)** | cmol(+)/kg | 1.39 |
| **Magnesium (Amm-acet.)** | cmol(+)/kg | 8.04 |
| **Sodium (Amm-acet.)** | cmol(+)/kg | 1.88 |
| **Aluminium (KCl)** | cmol(+)/kg | 0.07 |
| **Cation Exch. Cap.** | cmol(+)/kg | 20.91 |
| **Calcium/Magnesium Ratio** | | 1.19 |
| **Sodium % of Cations (ESP)** | % | 9.0 |
| **Aluminium Saturation** | % | 0.3 |
| **Aluminium (KCl)** | mg/kg | |
| **Calcium (Amm-acet.)** | % | |
| **Magnesium (Amm-acet.)** | % | |
| **Potassium (Amm-acet.)** | % | |
| **Phosphorus Environmental Risk Index** | | |
| **Copper (DTPA)** | mg/kg | 2.85 |
| **Iron (DTPA)** | mg/kg | 62.7 |
| **Manganese (DTPA)** | mg/kg | 28.94 |
| **Zinc (DTPA)** | mg/kg | 0.42 |
| **Boron (Hot CaCl2)** | mg/kg | 3.23 |

***Field Applied Research (FAR) Australia and Irrigated Cropping Council gratefully acknowledges the investment support of the GRDC in order to generate this research, project partners and the input of Southern Growers and IREC in managing the irrigation for this research trial.***



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