



Optimising Irrigated Grains (FAR1906-003RTX) A Grains Research & Development Corporation (GRDC) investment

PROVISIONAL HARVEST RESULTS:

Irrigated Soil Amelioration 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 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 (%).

Treatment Rate & Timing (Conducted 17-Mar 2020)	Grain yield and quality	
	Yield t/ha	Protein %
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.

Treatment	Normalised differential vegetation index (NDVI)	
	GS22 (early vegetative) (0-1)	GS62 (early flower) (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/m ²	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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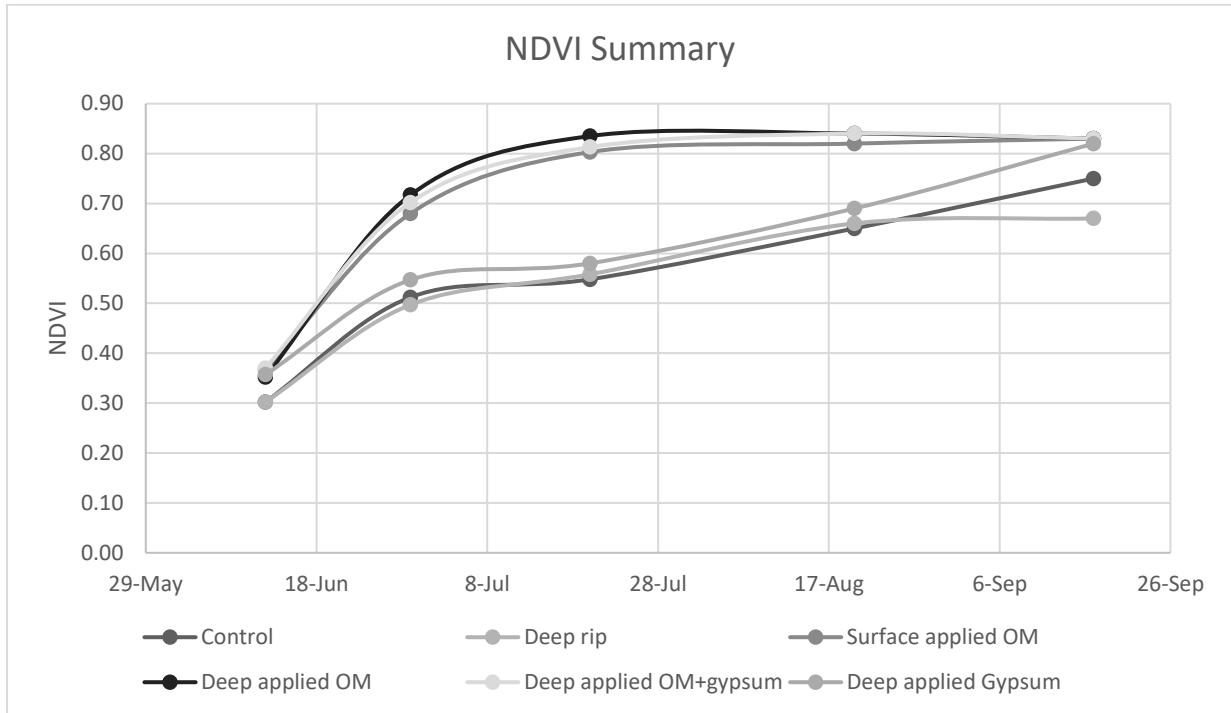


Figure 1. NDVI measurement June – September.

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.



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/m ² 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/m² 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

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Meteorological Data

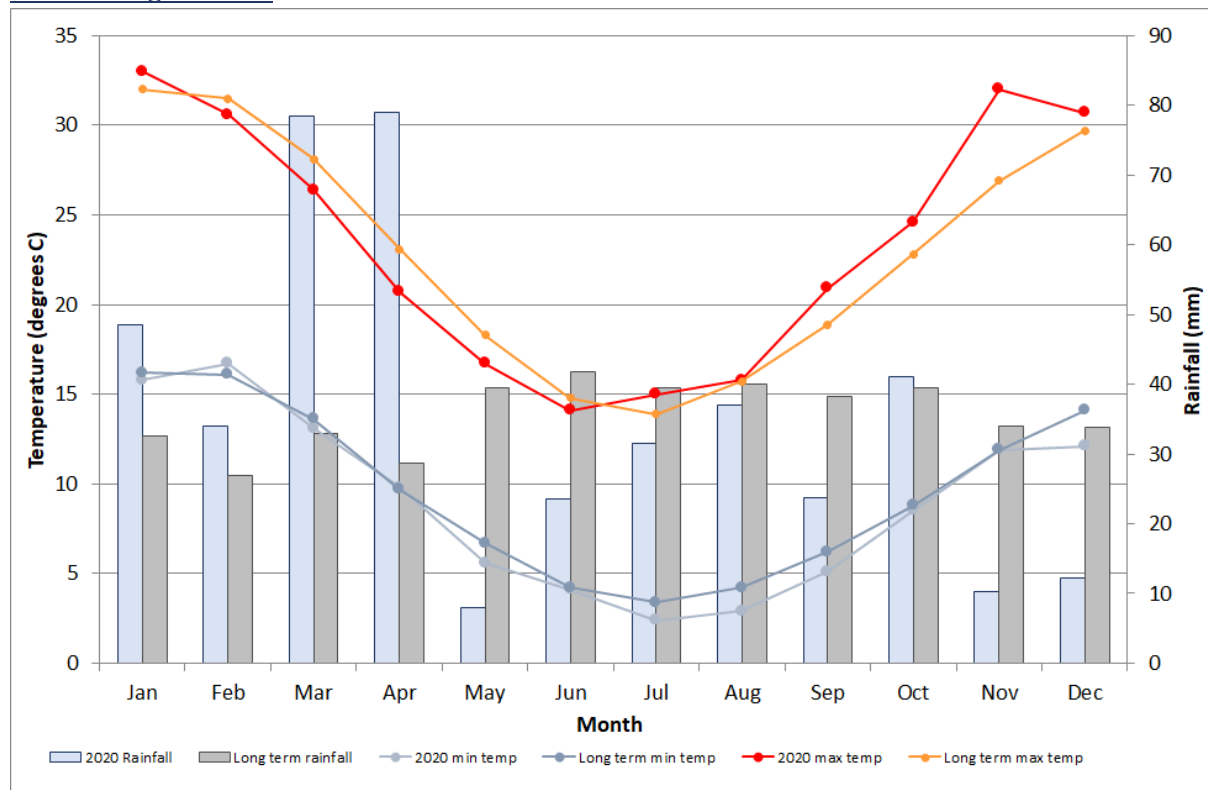


Figure 1. 2020 annual rainfall and long-term rainfall (1897-2020) (recorded at Finley), 2020 min and max temperatures and long-term min and max temperatures (1970-2020) (recorded at Tocumwal Airport). Rainfall April to October= 244.0mm. For the period July-December, temperatures were monitored on site. 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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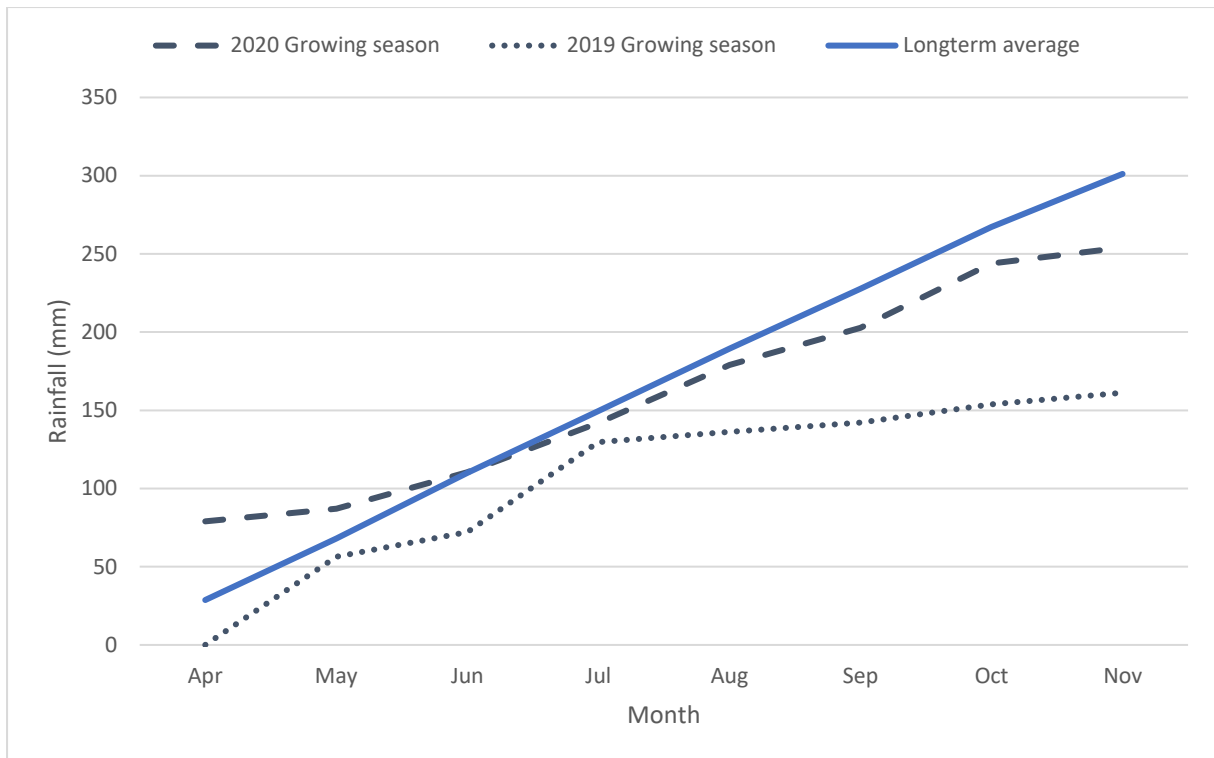


Figure 2. Cumulative growing season rainfall (April-November) for 2020, 2019, and the long-term average.

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Irrigation Schedule

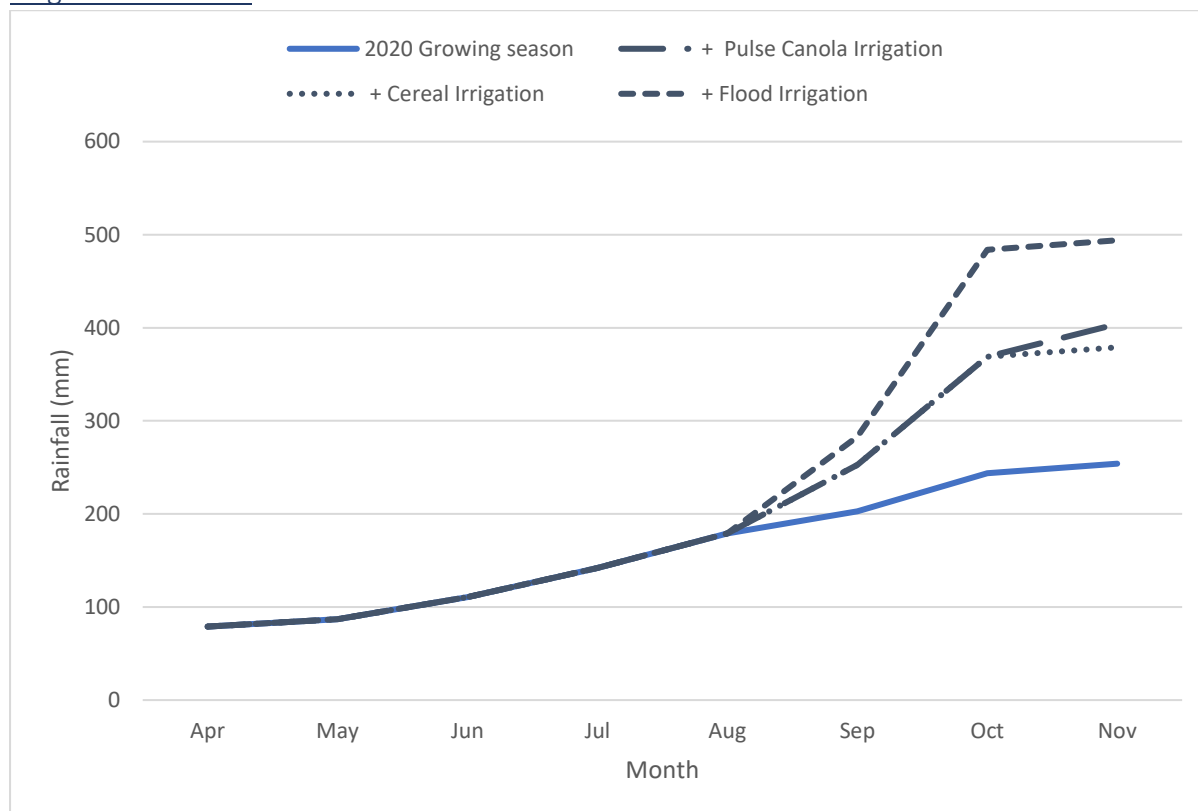


Figure 1. Cumulative 2020 growing season rainfall (April-November) plus irrigation delivered to cereal crops, pulse and canola crops and crops grown on flood irrigation.

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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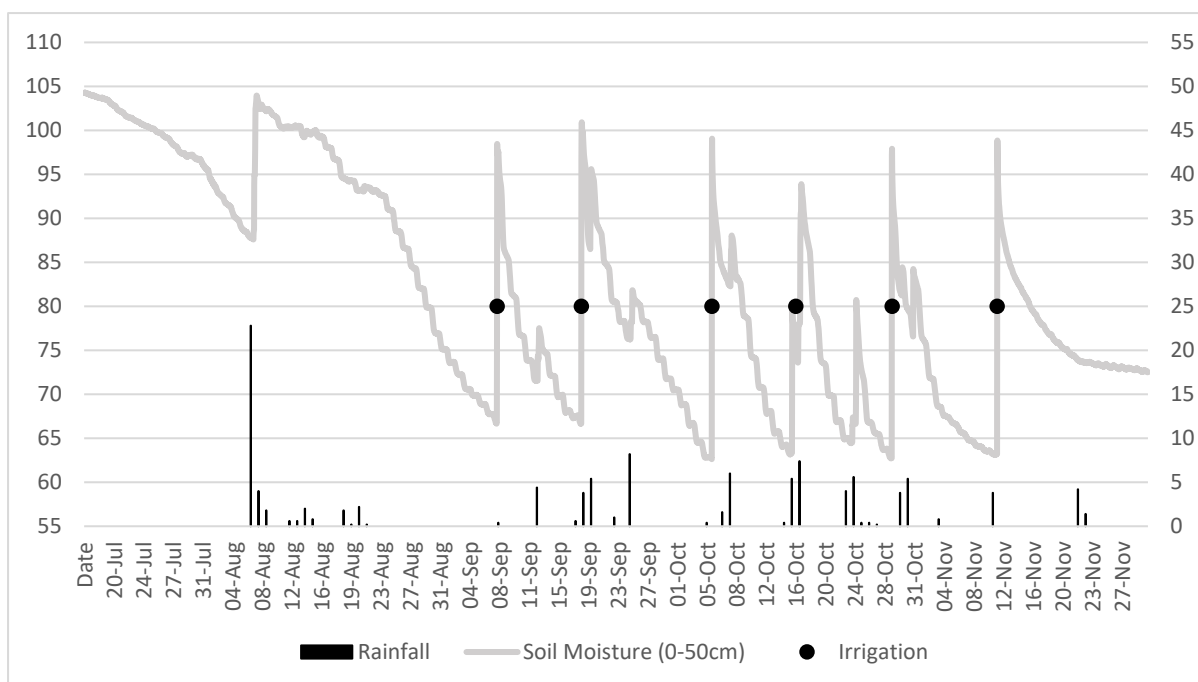


Figure 1. Linear overhead irrigation summed soil moisture data under faba beans (0-50cm).

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

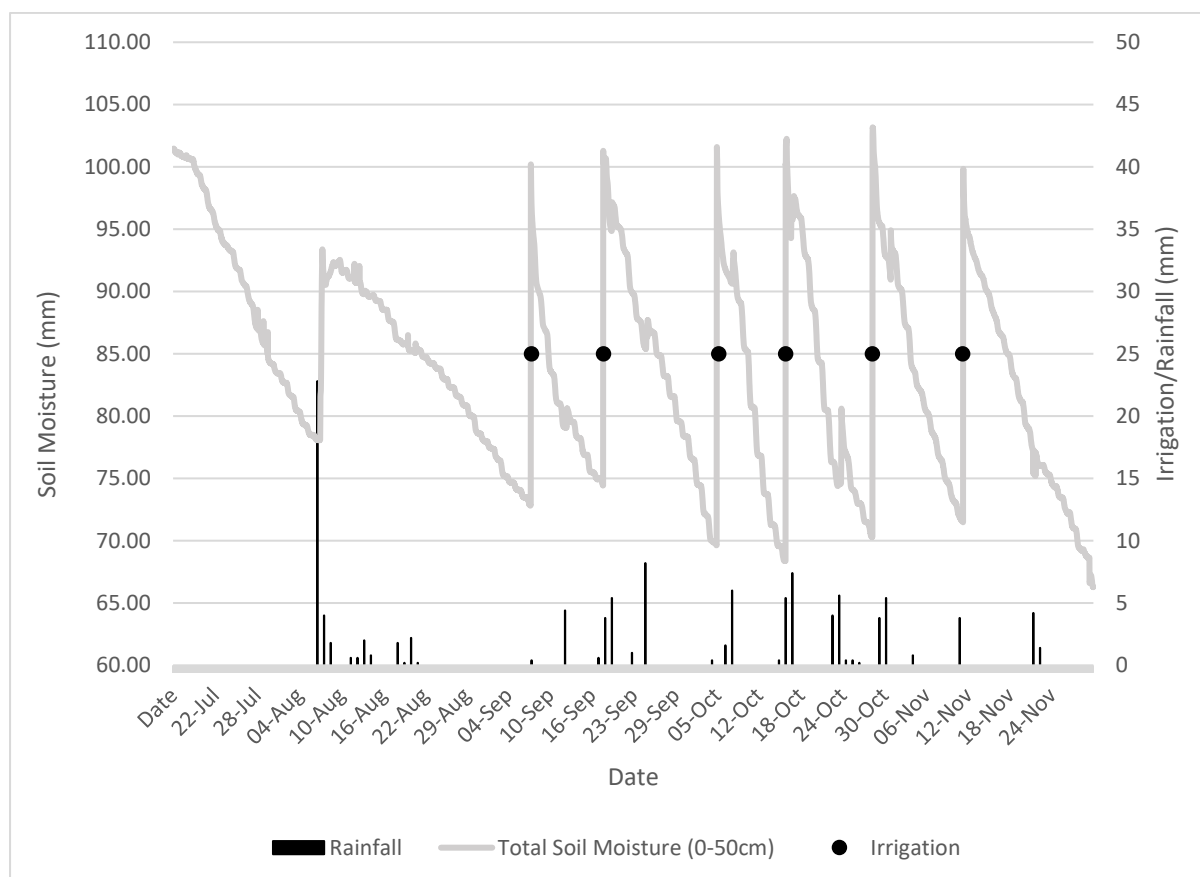


Figure 2. Overhead irrigation summed soil moisture data (0-50cm) for canola showing the effect of 6 x 25 mm/ha (total 150mm) irrigation under trial 3 & 4.

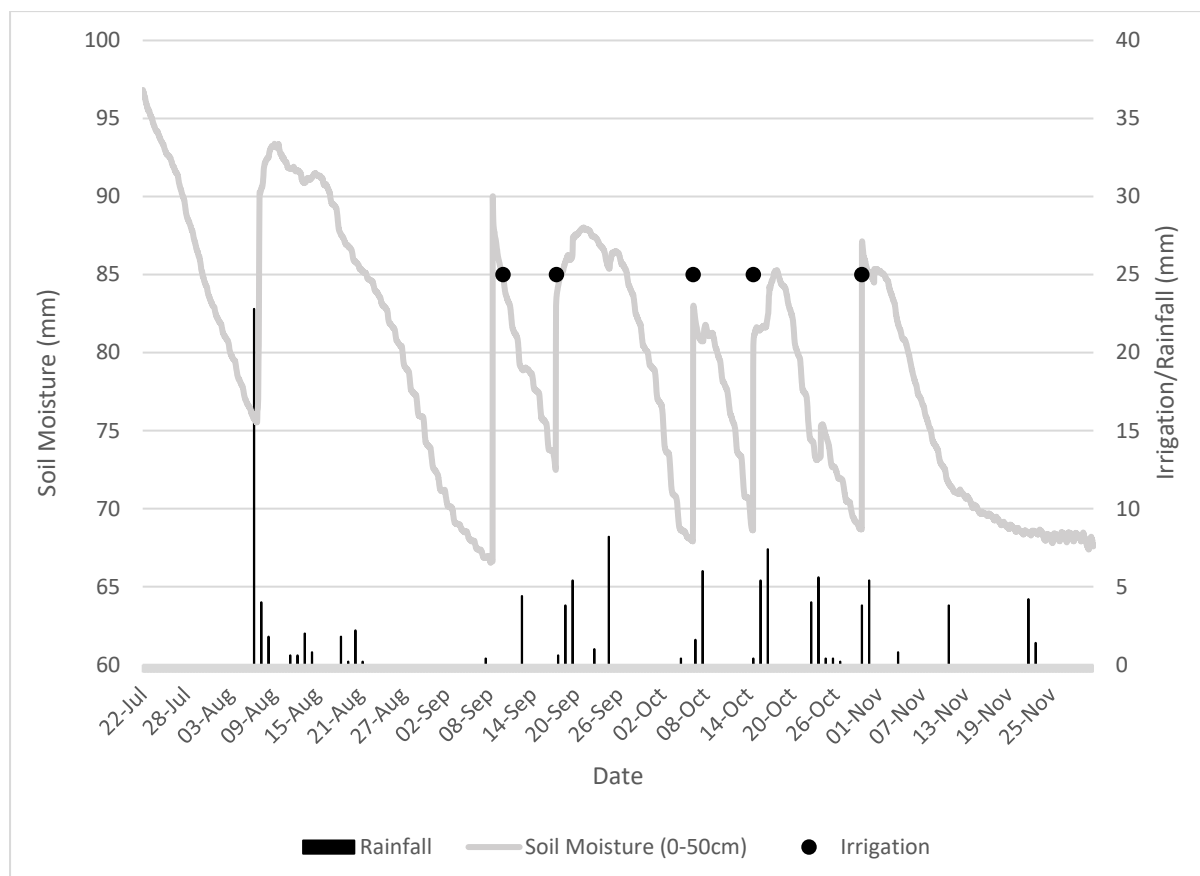
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Table 5. Barley irrigation schedule.

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

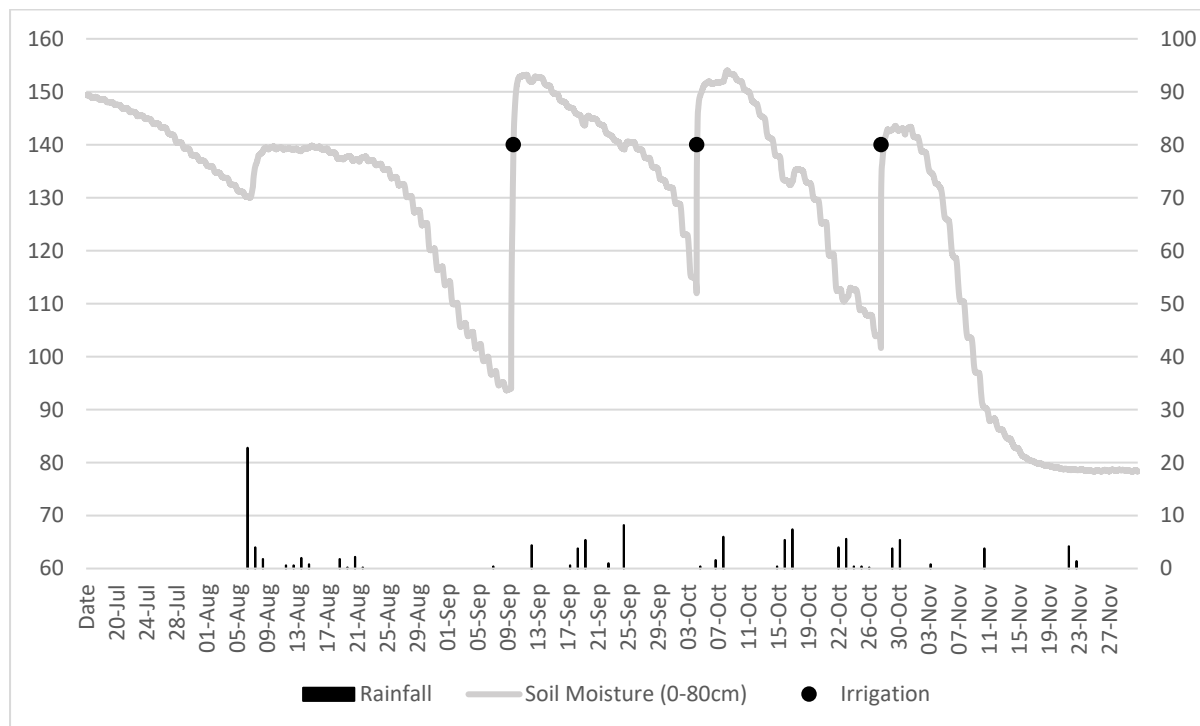


Figure 1. Durum flood irrigation summed soil moisture data (0-80cm).

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

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		
Innocation:	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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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			
	12/05/2020			12/05/2020			
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

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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

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Southern Farming Systems

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.

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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 CaCl ₂)		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

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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

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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 CaCl ₂)	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 CaCl ₂)		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

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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

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Meteorological Data

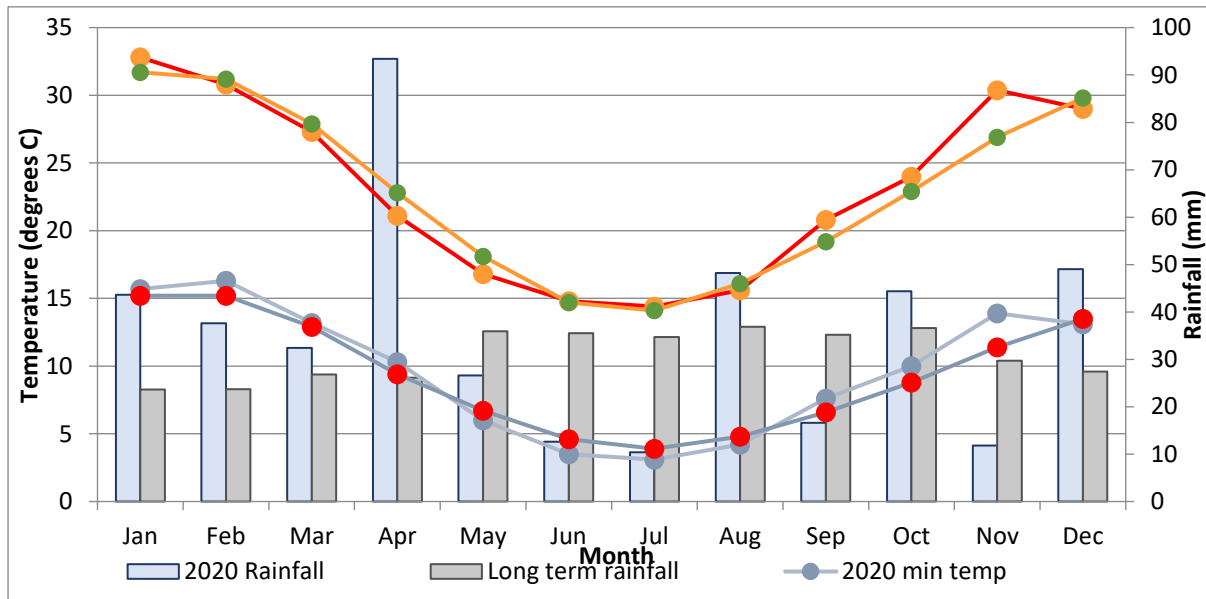


Figure 1. 2020 annual rainfall and long-term rainfall (1880-2020) (recorded at Kerang), 2020 min and max temperatures and long-term min and max temperatures (1903-2020) (recorded at Kerang). Rainfall April to October= 252.2mm.

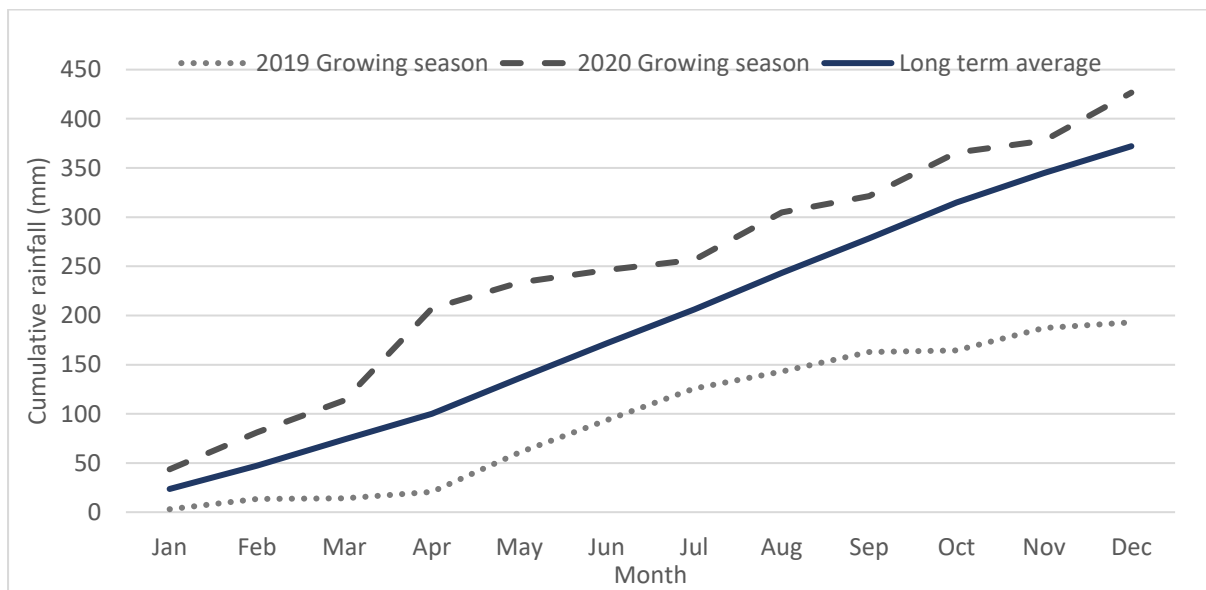


Figure 2. Cumulative growing season rainfall (April-November) for 2020, 2019, and the long-term average.

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Irrigation Schedule

Overhead irrigation

Table 1. Faba bean sprinkler irrigation schedule.

Date	Irrigation Applied (mm)
	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.

Date	Irrigation Applied (mm)
	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.

Date	Irrigation Applied (mm)
	Trial 1
28-Aug	26
14-Sep	26
24-Sep	30
14-Oct	30
Total	112

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

Date	Irrigation Applied (mm)	
	Trial 2, 3 & 4	
9-Apr	150	
9-Sep	90	
7-Oct	90	
Total	330	

Table 2. Chickpea flood irrigation schedule.

Date	Irrigation Applied (mm)		
	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.

Date	Irrigation Applied (mm)		
	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

Date	Irrigation Applied (mm)	
	Trial 2, 3 & 4	
24-Apr	130	
9-Sep	90	
7-Oct	80	
Total	300	

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Table 5. Barley flood irrigation schedule.

Date	Irrigation Applied (mm)
	Trial 1
8-Apr	150
17-Aug	80
23-Sep	90
14-Oct	80
Total	400

Table 6. Amelioration trial irrigation flood schedule.

Date	Irrigation Applied (mm)
	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/m ²			
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			

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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/m ²			
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/m ²			
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/m ²			
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/m ²			
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				148			
Ammonium Nitrogen	kg/ha	171				236			
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	0.151				0.218			
Chloride	mg/kg	0.151				0.218			
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	0.2				0.2			
Calcium (Amm-acet.)	%	0.2				0.2			
Magnesium (Amm-acet.)	%	0.2				0.2			
Potassium (Amm-acet.)	%	0.2				0.2			
Phosphorus		0.2				0.2			
Environmental Risk Index		0.2				0.2			
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						
	7/05/2020										
Sampling Date	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	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 CaCl ₂)	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				
	7/05/2020				7/05/2020				
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 CaCl ₂)		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 CaCl ₂)	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 CaCl ₂)		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 CaCl ₂)	mg/kg	3.16

Table 6 Amelioration

Paddock Name		Trial O20-06a-1			
Sampling Date		7/05/2020			
Sample Depth		0-10	0-30	30-60	60-90
	cm	cm	cm	cm	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 CaCl ₂)		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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Meteorological Data

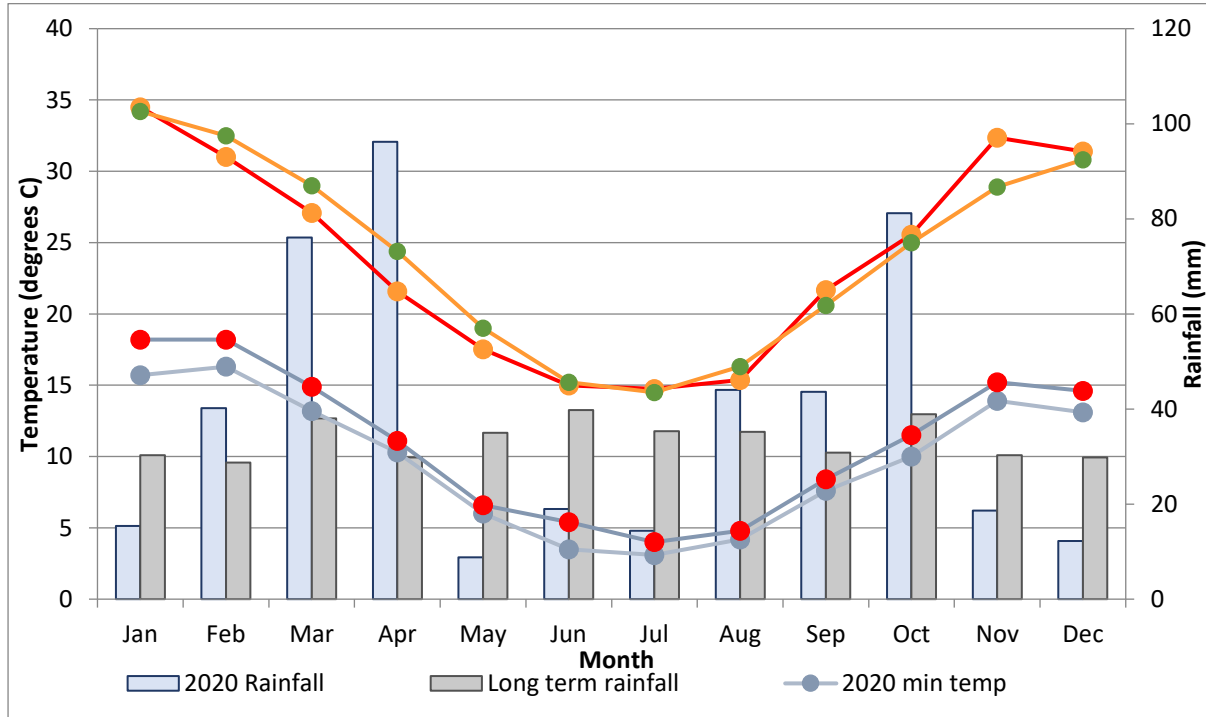


Figure 1. 2020 annual rainfall and long-term rainfall (1886-2020) (recorded at Whitton), 2020 min and max temperatures and long-term min and max temperatures (2000-2020) (recorded at Yanco). Rainfall April to October= 252.2mm.

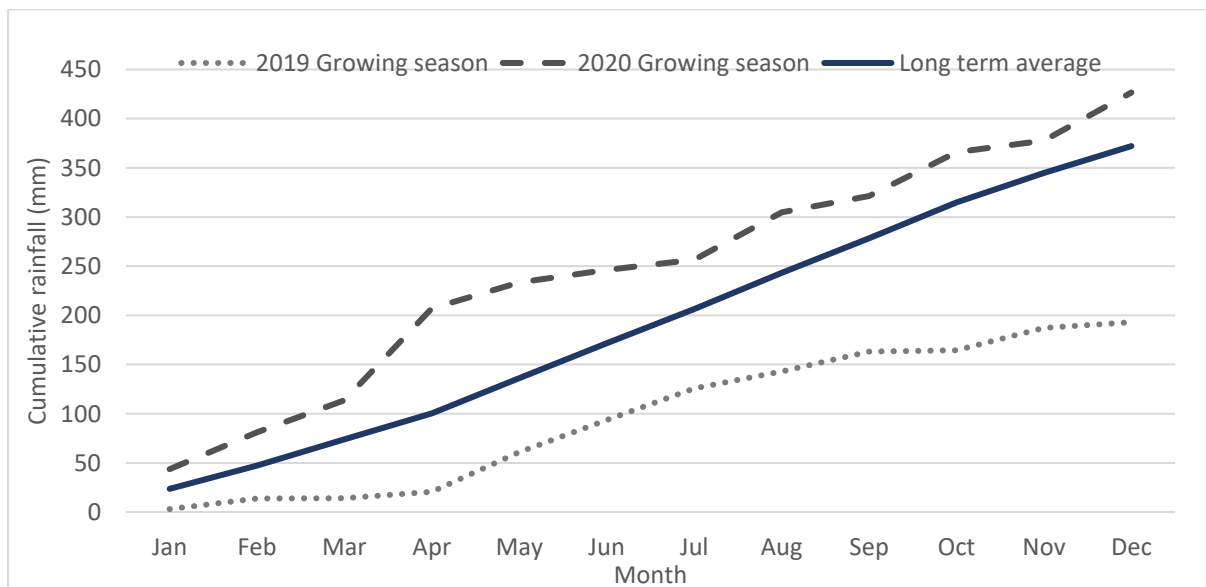


Figure 2. Cumulative growing season rainfall (April-November) for 2020, 2019, and the long-term average.

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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/m ²		
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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