Optimising Irrigated Grains

MAIZE TRIALS FIELD WALK

Friday 29 January 2021

Teagues Road, Peechelba East, VIC

Trial site courtesy of
Dan and Neil Coulthard

Regional project partners:

VISITOR INFORMATION

We trust that you will enjoy your morning with us at the Peechelba Irrigated Research Centre. Your health and safety is paramount, therefore whilst on the property we ask that you both read and follow this information notice.

HEALTH & SAFETY

- COVID-19: Please ensure you practice social distancing rules and use the hand sanitiser provided.
- All visitors are requested to follow instructions from FAR Australia staff at all times.
- All visitors to the site are requested to stay in your designated groups (if applicable).
- All visitors are requested to report any hazards noted directly to a member of FAR Australia staff.

FARM BIOSECURITY

- Please be considerate of farm biosecurity. Please do not walk into farm crops without permission. Please consider whether footwear and/or clothing have previously been worn in crops suffering from soil borne or foliar diseases.

FIRST AID

- We have a number of First Aiders on site. Should you require any assistance, please ask a member of FAR Australia staff.

LITTER

- Please take your litter away with you, please do not dispose of any litter on site.

VEHICLES

- Vehicles will not be permitted outside of the designated car parking areas. Please ensure that your vehicle is parked within the designated area(s).

SMOKING

- There is No Smoking permitted on site.

Thank you for your cooperation, enjoy your morning.

WELCOME TO THE PEECHELBA IRRIGATED RESEARCH CENTRE MAIZE TRIALS FIELD WALK

FEATURING OPTIMISING IRRIGATED GRAINS

On behalf of the project team, I am delighted to welcome you to the 2021 Peechelba Irrigated Research Site Maize Trials Field Walk featuring 'Optimising Irrigated Grains'.

Today FAR Australia will showcase its field research site which has been set up as part of a GRDC funded Initiative "Optimising Irrigated Grains". The irrigated research site aims to develop and evaluate the effectiveness of novel soil management technologies and crop specific agronomic management practices on system profitability. Crop specific agronomic practices focus on maximising system profitability through:

- optimising the return on nitrogen through improved use efficiency;
- improving the understanding of N-form, timing and rate in the context of irrigation timing and inter-related agronomic decisions; and
- understanding how to consistently optimise yield (in the context of water price, input costs and commodity price) for the crops where gaps are most apparent:

Soil management technologies will focus on improving soil structure, infiltration and moisture retention on (i) shallow and poorly structured red duplex soils ii) sodic grey clays prone to dispersion and waterlogging.

Which Crops?
The crops to be researched as part of the project are:
i) Faba bean (the pulse crop seen with the most potential for irrigated systems), ii) chickpea (an emerging high value pulse, important in crop sequences to provide a cereal disease break), iii) durum (the major option to increase the profitability of the cereal phase under irrigation), iv) canola (higher yields provide scope for significant increase in profitability and potential break effect) and v) maize (the summer crop with the greatest scope to improve returns under a double cropping system).
In tendering for the project, the project team added a sixth crop which is barley. This will be based on spring sown barley in Tasmania and winter barley where appropriate on the mainland.

How will the project objectives be achieved?
The objectives of the project will be underpinned by 66 field trials conducted annually at five Irrigated Research Centres (IRCs). The principal Research Centres at Kerang and Finley will cover all four autumn sown crops (faba beans, chickpeas, durum, and canola) with the addition of maize sown in the spring. Satellite centres will be established in Frances, Griffiths and Tasmania with a smaller number of trials per annum. Each year six trials will be reserved for other regions (e.g. Yarrawonga, Coleambally, Corop) that have smaller acreages of irrigated broad acre will be serviced by individual

trials covering different crop and agronomic issues. The soil amelioration research to be conducted in collaboration with NSW DPI is based on two large block research trials at Kerang (Grey Clay under flood irrigation) and Finley (Red Duplex under overhead irrigation).

Today, FAR Australia's Managing Director will be joined by research staff Ben Morris and Tom Price who will tour you around the research trials talking about the trial objectives and inputs to date. We will be discussing:

- Is it possible to achieve high yields and still save on fertiliser costs?
- How important is soil N supply in underpinning high yields?
- What alternative nutrition strategies can we adopt?
- Influence of plant population on dry matter production and grain yield.

Should you require any assistance throughout the day, please don't hesitate to contact a member of the FAR Australia team who will be more than happy to help.

Thank you once again for taking the time to join us today; we hope that you find the trials tour and discussions useful, and as a result, take away new ideas which you can perhaps implement in your own farming business. Have a great day and we look forward to seeing you again at future project events.

I would like to thank the GRDC for investing in this research programme on display today and to Dan and Neil Coulthard as site hosts.

Nick Poole
Managing Director
FAR Australia

FAR1906-003RTX: Development and validation of soil amelioration and agronomic practices to realise the genetic potential of grain crops grown under a high yield potential, irrigated environment in the northern and southern regions is part of a wider GRDC funded project in irrigated grain production called "Optimising Irrigated Grains" involving a wide range of collaborators.

Maize Protocols and Treatment Lists

The following treatments lists and assessment protocols evaluate nitrogen use efficiency in irrigated grain maize under different rates and timings of applied N fertiliser.

The individual objectives are as follows:

- Evaluating nitrogen use efficiency under different N rates and timings in grain maize (0 – 567kg N/ha total N).
- Influence of plant population on nitrogen use efficiency and harvest index.
- Evaluate the influence of macro and micro nutrient rates and timings on grain maize.
- Influence of fungicide timing and rate for the prevention of disease and green leaf retention in grain maize.

All plots will be assessed for final harvest dry matter, grain yield and final nitrogen content in the maize stover (stalks, leaves, husks, and cobs) and maize grain so that nitrogen offtake can be calculated and harvest index can be calculated.

Paddock Details:
Sowing Date: 4 November 2020
Hybrid: Pioneer Hybrid 1756
Emergence Date: 13 November 2020
Starting soil N (13 October – taken before N application): **0-30cm** =49 kg/ha, **30-60cm** = 62 kg/ha.
First Water: 4 November 2020
Water Applied: 3.5 ML to date.

Crop Management Details:
Crop Nutrition

No.	Date	Product	Rate/ha	Placement
1	4 November	MAP	220 kg/ha	With Seed
		Worm Juice	10 L/ha	With Seed
		Cotton Starter	30 L/ha	With Seed
3	Split over 3 applications timings	Urea	500 kg/ha	Fertigation
4	Mid Crop	Worm Juice	5 L/ha	Boom Spray
		SL tec TE 8	3 L/ha	Boom Spray
		MOP 25	250 ml/ha	Boom Spray

Crop Protection

No.	Date	Product	Rate/ha	Placement
1	3/11/20	Glyphosate	2.5 L/ha	Pre sow Knock Down
2	4/11/20	Dual Gold	1 L/ha	Post sow-Pre Emerg
		Atrazine	2.5 kg/ha	Post sow-Pre Emerg
		Lorsban	1 L/ha	Post sow-Pre Emerg
3	Pre Tassel	Altacor	70 g/ha	Foliar
		Paramite	350 ml/ha	Foliar

Meteorological data:

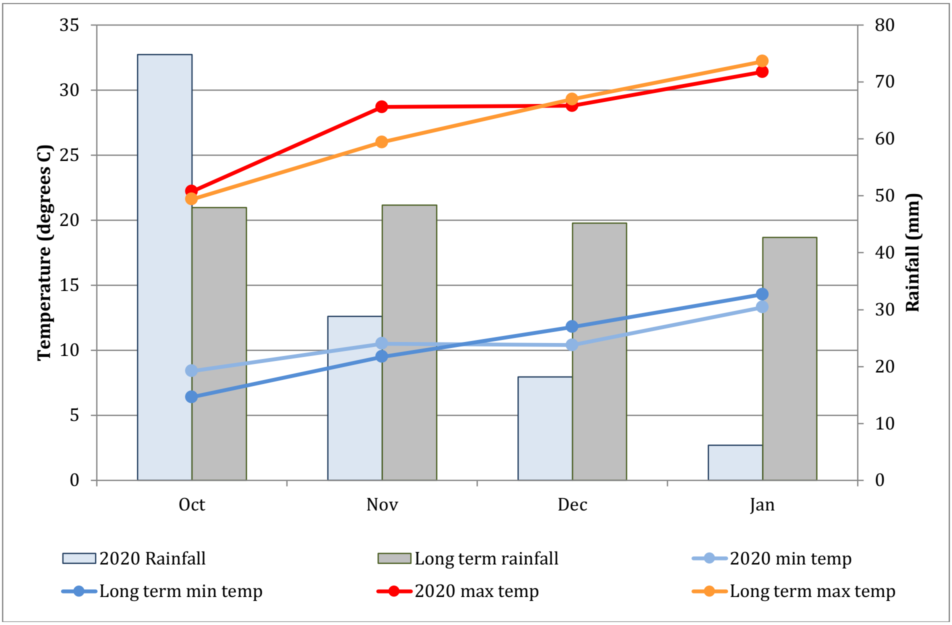

Figure 1. 2020 growing season rainfall and long-term rainfall (1987-2020) (recorded at Wangaratta Airport), 2020 min and max temperatures and long-term min and max temperatures recorded Wangaratta Airport (1987-2020) for the growing season so far (October- 20th January). *Rainfall and irrigation October to 20th January= 128.0mm + 350mm (478mm).*

Trial 1: Nitrogen Use Efficiency Trial – N rates

Location: Peechelba East, VIC 3678

Trial treatments: Eight rates of pre-drill N (46% N solid urea fertiliser) when N dose is standardly applied as fertigation.

Hybrid: Pioneer Hybrid 1756

Emergence: 93,000 plants/m^2

Treatment list:

Trt.	Pre-drill kg N/ha	Post – em (kg N/ha)	Total (kg N/ha)
1	0	252	252
2	45	252	297
3	90	252	342
4	135	252	387
5	180	252	432
6	225	252	477
7	270	252	522
8	315	252	567

Trial 2. Nitrogen Use Efficiency Trial – N Timing

Location: Peechelba East, VIC 3678

Trial treatments: 3 N timings (pre-drill, 2weeks post sow, 4 weeks post sow) x 3 N rates x 4 replicates

Hybrid: Pioneer Hybrid 1756

Emergence: 93,000 plants/m^2

Treatment list:

Trt.	Timing (1st N dose)	N rate (1st N dose) (Kg N/ha)	Standard 2nd N dose (Kg N/ha)	Total (Kg N/ha)
1	Pre drill	0	252	252
2	Pre drill	90	252	342
3	Pre drill	180	252	432
4	3-4 leaf	0	252	252
5	3-4 leaf	90	252	342
6	3-4 leaf	180	252	432
7	6-8 leaf	0	252	252
8	6-8 leaf	90	252	342
9	6-8 leaf	180	252	432

Trial 3. Nitrogen Use Efficiency – Plant population trial x nitrogen interaction

Location: Peechelba East, VIC 3678

Trial treatments: 3 plant populations x 3 N rates applied pre-drill x 4 replicates

Hybrid: Pioneer Hybrid 1756 sown at 3 populations

Treatment list:

Trt.	Plant pop (seeds sown/ha)	N rate 1st N dose (Kg N/ha)	Standard (2nd N dose) (Kg N/ha)	Total
1	83,000	0	252	252
2	83,000	90	252	342
3	83,000	180	252	432
4	93,000	0	252	252
5	93,000	90	252	342
6	93,000	180	252	432
7	103,000	0	252	252
8	103,000	90	252	342
9	103,000	180	252	432

<u>Trial 4. Alternate Nutrition Strategies – Macro and Micro Nutrient Monitoring</u>
Location: Peechelba East, VIC 3678
Trial treatments: 4 nutrient strategies x 2 N rates x 4 reps
Hybrid: Pioneer Hybrid 1756

Treatment List:

Trt.	Pre-drill N (kgN/ha)	Alternate Nutrition Strategy	Post em N (kgN/ha)	Total
1	0	Nil (control)	252	252N
2	0	Potassium Chloride (160kg/ha)	252	252N + 80K
3	0	Calcium Nitrate (400L/ha)	252	304N + 74Ca
4	0	Natures K (600L/ha)	252	252N + 60K
5	90	Nil (control)	252	342N
6	90	Potassium Chloride (160kg/ha)	252	342N + 80k
7	90	Calcium Nitrate (400L/ha)	252	394N + 74Ca
8	90	Natures K (600L/ha)	252	342N + 60K

<u>Trial 5. Influence of modern fungicides on the yield potential of grain maize</u>
Location: Peechelba East, VIC 3678
Trial treatments: 4 fungicide programs x 2 fungicide timings (V8 & VT) x 4 replicates
Hybrid: Pioneer Hybrid 1756

Treatment List:

The treatment list contains a mixture of commercial and experimental fungicide applications.

2019 Grain Maize Results Summary

12 irrigated grain maize trials were established at five locations in northern Victoria and southern NSW. The primary focus of the field research was to examine nutrition, looking specifically at the influence of higher levels of nitrogen (N) input on harvest dry matter, grain yield, harvest index and nitrogen offtake. In addition, the research programme also examined the influence of plant population, row spacing and disease management. At the main research sites Peechelba East and Kerang Irrigation was provided by overhead pivot and flood (border check) respectively. Irrigation quantities were as follows, Peechelba East (Pivot 6.08 Mega L/ha applied), Boort (Sub surface drip n/a), Hopefield (Pivot 6.88 ML/ha applied), Kerang (Flood border check 9.8 ML/ha) and Yenda (Flood, beds in bays 9.1 ML/ha). Research was conducted using the Pioneer Hybrid 1756.

Grain yields and harvest dry matter production

At Peechelba East in North East Victoria the highest grain yields (machine harvested plots) were 18 – 19t/ha produced on crop canopies with a final harvest dry matter of between 30 – 35t/ha. At Kerang (machine harvested plots), the highest grain yields were typically between 16-17t/ha, again produced on crop canopies of approximately 30t/ha. Grain yields of 20t/ha were observed at Boort and Yenda from hand harvested quadrats, however it should be noted that smaller quadrats harvested from plots are generally more variable and higher yielding than machine harvested yields.

Nutrition

At Peechelba East on a red loam over clay grain yields of 18.12-18.80 t/ha were produced with applied fertiliser input no greater than 207-252kg N/ha (207 kg N/ha of which was applied as fertigation between V4 and pre – tasselling). At this site following oaten hay (33kg N/ha was available at sowing (0-60cm)) there was no significant yield difference between applying 0 – 315kg N/ha applied pre-drill (as urea - 46% N solid prill) indicating that N application exceeding 250kg N/ha was uneconomic. At Kerang on a self-mulching grey clay the optimum fertiliser N input was 240kg N/ha with a yield of 16.43t/ha. At Peechelba East and Kerang fertiliser N applications greater than 250kg N/ha (up to over 500-550kg N/ha) were uneconomic. At both research sites N provided by the soil through mineralisation appeared to have a large effect on the results, since at Peechelba East N offtake at harvest revealed between 400 – 450kg N/ha in crop canopy, whilst at the same time there was no response to N fertiliser above 207-252kg N/ha. Typically, two thirds of the N present in the crop at harvest at Peechelba East was found in the grain with the remainder in the stover. Allowing for N available at sowing the results indicated that 165kg N/ha of the N in the crop at harvest was provided by mineralisation. In Kerang where the maize was grown following a three-year grass pasture phase the optimum level of applied N fertiliser was 240kg N/ha with a nitrogen offtake at harvest of 310kg N/ha at harvest, of which approximately 73% was present in the grain. Evidence from the zero N plots at this site indicated that up to 207kg N/ha in the final crop canopy came from soil mineralisation.

Additional Potassium (K) applications (20-80kg K/ha) at Kerang and Yenda on soils with levels of K at 500-600ppm gave no indications of luxury K uptake into leaf tissue or grain and no economic return in terms of yield. Optimising Irrigated Grains – Maize Agronomy in Focus 2019/2020 Results

Plant population & row spacing

At Boort decreasing row spacing from 750mm (approx. 30 inch) to 500mm (approx. 20inch) significantly increased grain yield with a 3.21 t/ha yield increase (trials hand harvested). In the same trial there were no significant effects of plant population when 90,000 plants/m2, 105,000 and 120,000 plant populations were compared. At Peechelba East the lowest plant population 79,287 plants/ha resulted in the lowest yields with no grain yield difference between 91,864 and 103,620 plants/ha. At Kerang in a variable trial there was no yield differences between 750 and 500mm row spacing or target plant populations of 85,000 plants/m2 or 120,000 plants/m2. Although no grain yield differences were recorded it was noted that narrower row spacing produced more overall harvest biomass at the lower plant population of 85,000 plants/m2.

Disease Management

Three trials looking at experimental treatments based on triazole (Group 3 DMIs) and strobilurin (Group 11 QoI) fungicides produced no economic response to application and no evidence of increased green leaf retention in the maize canopy. No disease was observed in these three trials.

RESULTS

Protocol 3 & 4. Optimum timings and rates for the nitrogen (N) forms applied in irrigated crops of maize.

Trial 1. Nitrogen Use Efficiency Trial – influence of rate

Protocol Objective:

To evaluate nitrogen use efficiency in grain maize under different rates and of applied N fertiliser applied as pre drill urea (46% N) prior to fertigation with an overhead lateral.

Peechelba East, Victoria

Sown: 13 November 2019
Harvested: 31 May 2020
Soil Type: Red loam over clay
Previous crop: Oaten hay

Hybrid: Pioneer Hybrid 1756
FAR code: FAR IRR M19-01-1
Irrigation Type: Overhead pivot

Key Points:

- *Header grain yields averaged 18.49t/ha with no yield benefit observed from applying pre-drill urea in the trial when N was applied post sowing as fertigation.*
- *In a trial with an overall dose of post sowing N of 207 kg N/ha applied via fertigation there was no value to the earlier pre-drill N applications of between 0 – 315kg N/ha.*
- *No significant differences were recorded in dry matter offtake at V4 or harvest between N treatments representing between 207 – 522 total kg N/ha applied.*

- *The N offtake at harvest revealed an average N content of 426kg N/ha with a range of approximately 390-450kg N/ha in the crop.*
- *The N offtake at harvest indicated soil mineralisation provided up to 165kg N/ha to grow the crop with lower N efficiency recorded from applied fertiliser at higher overall N rates.*
- *There were no significant differences in test weight (mean 81.1) or harvest index (mean 47.8%).*

Table 1: Grain yield (t/ha @ 14% moisture) test weight (kg/hL) and harvest index (HI %), 31 May 2020.

Treatment				Seed Yield and Quality					
	Pre-drill kg N/ha	**Post drill* kg N/ha**	**Total kg N/ha**	**Yield t/ha**		**Test Wt kg/hL**		**H.I %**	
1	0	207	207	18.12	-	81.0	-	49.8	-
2	45	207	252	18.80	-	81.0	-	50.3	-
3	90	207	297	18.32	-	81.3	-	46.7	-
4	135	207	342	19.02	-	81.2	-	45.8	-
5	180 (Farm)	207	387	18.63	-	81.3	-	44.9	-
6	225	207	432	18.12	-	81.6	-	46.2	-
7	270	207	477	18.54	-	80.8	-	47.1	-
8	315	207	522	18.34	-	81.2	-	52.3	-
	LSD			NS		NS		NS	
	Mean			18.49		81.1		47.8	
	P Val			0.991		0.926		0.296	
	CV			8.82		1.01		8.99	

** Post sowing nitrogen (207 N) was applied via fertigation with applications on V4 (46N), V8 (60N), pre-tasselling (101 N) on 10 Dec, 26 Dec, 14 Jan and Jan 15.*

Available soil N assessed prior to sowing 33 kg N/ha (0-60cm)
Harvest index based on grain and stover recorded at 0% moisture

Dry Matter offtake

Dry matter off-take at V6 stage averaged 0.55t/ha and showed no significant differences in dry matter across any rate of nitrogen applied pre-drill (data not shown). At early development stages V4 there were small differences in visual appearance and NDVI that suggested zero N pre-drill was not as green, however by V8 there was no difference in NDVI as fertigation application became available to the plant.

At harvest there was no difference in total crop dry matter with a mean of 33.2t/ha giving a mean harvest index of 47.8%

Table 2: Dry matter accumulation (t/ha) in maize at crop maturity, 7 May 2020.

Treatment		Harvest Dry Matter (recorded at 0 % moisture)							
Nitrogen (kg N/ha)		Stalks		Cobs		Grain		Total	
	Pre-drill	t/ha		t/ha		t/ha		t/ha	
1.	0	13.48	-	2.25	-	15.58	-	31.32	-
2.	45	13.79	-	2.42	-	16.16	-	32.38	-
3.	90	15.43	-	2.63	-	15.27	-	33.82	-
4.	135	16.84	-	2.70	-	16.36	-	35.89	-
5.	180 (Farm standard)	16.18	-	2.43	-	15.33	-	33.86	-
6.	225	15.50	-	2.59	-	15.58	-	33.67	-
7.	270	15.82	-	2.45	-	15.94	-	34.22	-
8.	315	12.42	-	2.11	-	15.77	-	30.30	-
	Mean	14.99		2.43		15.75		33.21	
	LSD	NS		NS		NS		NS	
	P Val	0.233		0.259		0.973		0.430	

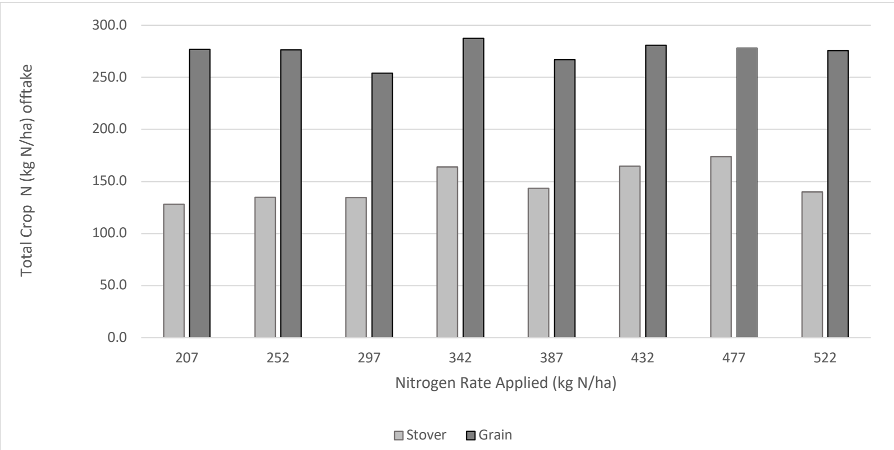

Figure 1. Total crop N (kg N/ha) offtake at harvest in the stover (stalks, leaves, husk) and grain

N offtake in the crop at harvest indicated that between approximately 400 and 450kg N/ha had been removed depending on applied N treatment, although none of the differences in N offtake were significant. Approximately 165kg N/ha was provided by mineralisation in the soil in crops where no pre-drilled urea was applied, with 33kg N/ha available in the soil at sowing. At higher levels of applied N fertiliser (477 & 522kg N/ha) more N fertiliser was applied than was recovered in the crop.

Table 3: Nitrogen content (kg N/ha) in maize at harvest, 31 May 2020.

Treatment		Harvest Nitrogen Content*			
Nitrogen (kg N/ha)		**Stalks**	**Cob husk**	**Grain**	**Total**
		N kg/ha	**N kg/ha**	**N kg/ha**	**N kg/ha**
1.	0	109.1 -	19.2 -	276.7 -	404.9 -
2.	45	115.1 -	19.7 -	276.6 -	411.4 -
3.	90	129.7 -	20.3 -	254.2 -	404.2 -
4.	135	142.3 -	21.6 -	287.4 -	451.3 -
5.	180 (Farm)	140.9 -	18.2 -	266.9 -	426.0 -
6.	225	144.1 -	20.5 -	280.9 -	445.5 -
7.	270	153.8 -	20.1 -	278.4 -	452.2 -
8.	315	122.8 -	17.2 -	275.8 -	415.8 -
	Mean	131.9	19.6	275.0	426.4
	LSD	NS	NS	NS	NS
	P Val	0.150	0.807	0.407	0.677

** Nitrogen content of stover (stalks, leaves and cob husk) calculated from dry matter at harvest and grain N taken from plot yield recorded with the harvester.*

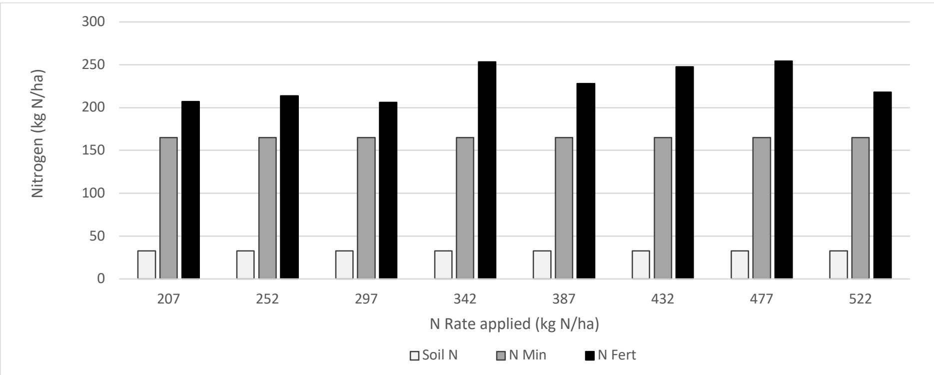

Figure 2: Assumed contribution of N fertiliser to total crop N offtake at harvest (if mineralisation was assumed to be the same in all treatments and that preferential N uptake of soil N rather than bag N was the case).

Note without specific N isotope studies it cannot be accurately calculated what proportion of N uptake by the plant came from the soil and what came from the fertiliser applied).

Table 4: Influence of N rate on leaf %N at V6 (6 leaf collar), R2 (blister stage) and R4 (dough stage).

Total N Applied		**Leaf N (%)**	
kg N/ha	**V6**	**R2**	**R4**
207	4.10	2.27	1.99
387	4.75	2.41	1.96
522	4.53	2.34	1.89

Table 5: Deep soil nitrogen test results (0-60cm).

Depth	0-30 cm	30-60 cm	Total
N (mg/kg)	12.6	16.0	
N (kg/ha)	49	62	111

Table 6: Pre-plant topsoil test result (0-30cm).

Nutrient		Result	
pH (water) pH (CaCl2)		5.80 4.80	
Sulphur	MCP	0.00	mg/kg
Chloride		17.00	mg/kg
Copper	DTPA	1.10	mg/kg
Zinc	DTPA	2.50	mg/kg
Manganese	DTPA	54.00	mg/kg
Iron	DTPA	42.00	mg/kg
Phosphorus	Colwell	82.00	mg/kg
Available Potassium	Amm-acet	100.00	mg/kg
Organic Carbon		0.68	%
Sodium % of cations		10.00	%
Aluminium saturation		5.20	%
EC		0.08	dS/m
Ca:Mg Ratio		2.30	
Exchangeable cations			
Potassium	Amm-acet	0.26	meq/100g
Calcium	Amm-acet	1.80	meq/100g
Magnesium	Amm-acet	0.77	meq/100g
Sodium	Amm-acet	0.34	meq/100g
Aluminium	KCL	0.17	meq/100g
CEC		3.32	meq/100g

SOWING THE SEED FOR A BRIGHTER FUTURE

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