Impact of Nitrogen rate and application timing on irrigated barley

FOCUS PADDOCK
from
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Aims

Different nitrogen rates and application timings will be examined to determine which management approach can maximise yield without compromising the end market.

The intention is to observe how such treatments impact yield and grain quality.

Background and Activities

Nitrogen is a critical element to plant growth and reproduction. It is a nutrient that is required more than any other, however, only small portions of the nitrogen in the soil is available to plants. This means that nitrogen-based fertilisers are required to assist in optimising grain yield and quality.

Through the GRDC Optimising Irrigated Grains project, the facilitated action learning group at Frances has conducted a replicated trial looking at varying nitrogen rates and application timings to try and maximise the yield and quality in Planet barley under irrigation.

The trial was sown on the 20th of May 2021 on a pivot site at Frances, which has previously been a long term lucerne crop.

Method

Treatment variables were nitrogen rates and application timings.

The different timings of application consisted of at seeding (GS00), first node (GS31) and flag leaf (GS37) different combinations were used at different rates to see where we can optimise grain yield and quality.

Nitrogen rate was the other variable. We used 4 different rates. 46kg of N per ha, 92 kg of N per ha, 138 kg of N per ha and 184 kg of N per ha. We also had 0kg of N per ha as a control.

The maximum rate was calculated to try and achieve a potential yield of 10t/ha. This was done by taking account of the nitrogen in the soil profile down to 90cm. This value of available nitrogen was then subtracted off what N was required per tonne of yield (using industry standards) to give us the amount required to be top dress fertiliser. These calculations made an assumption that 50kg N may become available from the mineralisable pool within the soil.

Table 1. Nitrogen rate calculations, including starting soil N and mineralised N assumptions.

Target Yield t/ha	N required to achieve yield	NO_3 mg/kg	NH_4 mg/kg	Total Deep N kg/ha	Mineralised N	Additional N required	Actual applied N kg/ha
10	300	4.1	2	66	50	184	Up to 184kg

Figure 1, from left 184kg N/ha, middle 0kgN/ha, right looking over the plots at vigour difference

Results

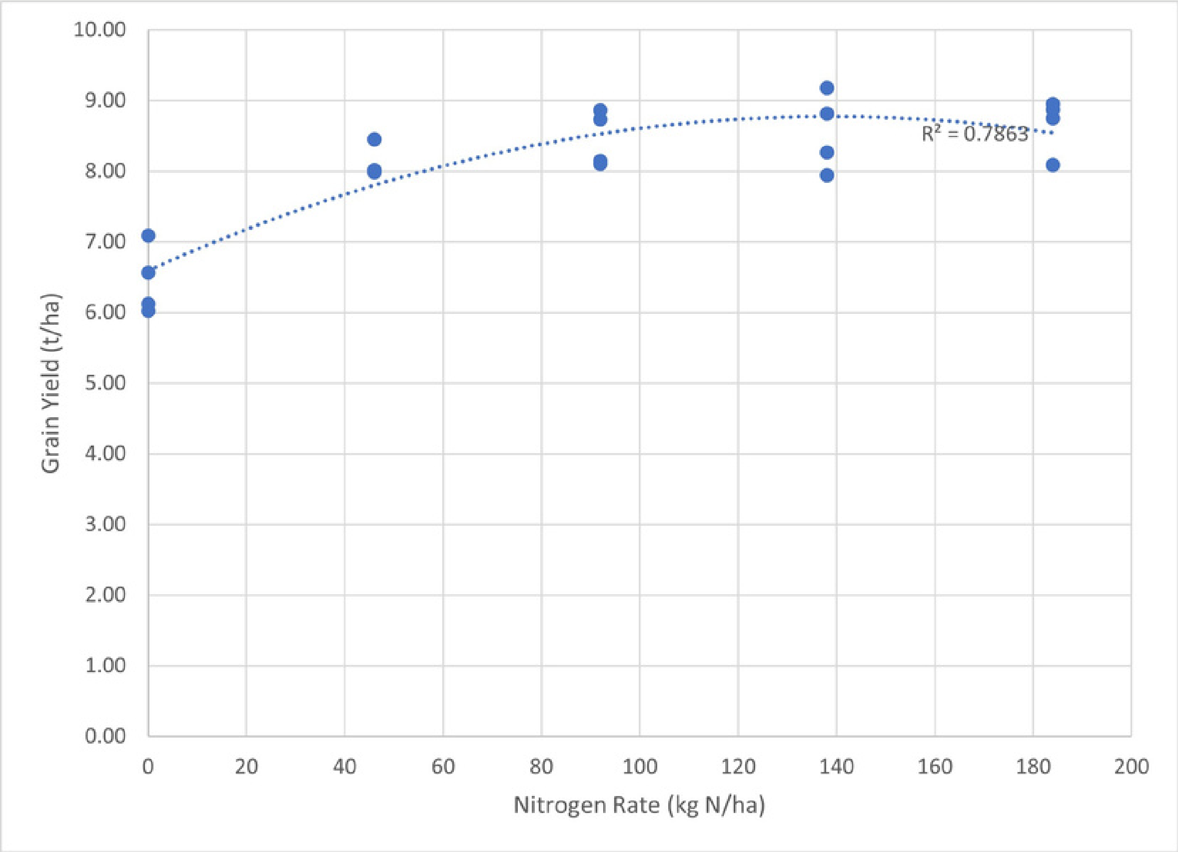

Figure 2. Grain Yield response curve to additional nitrogen

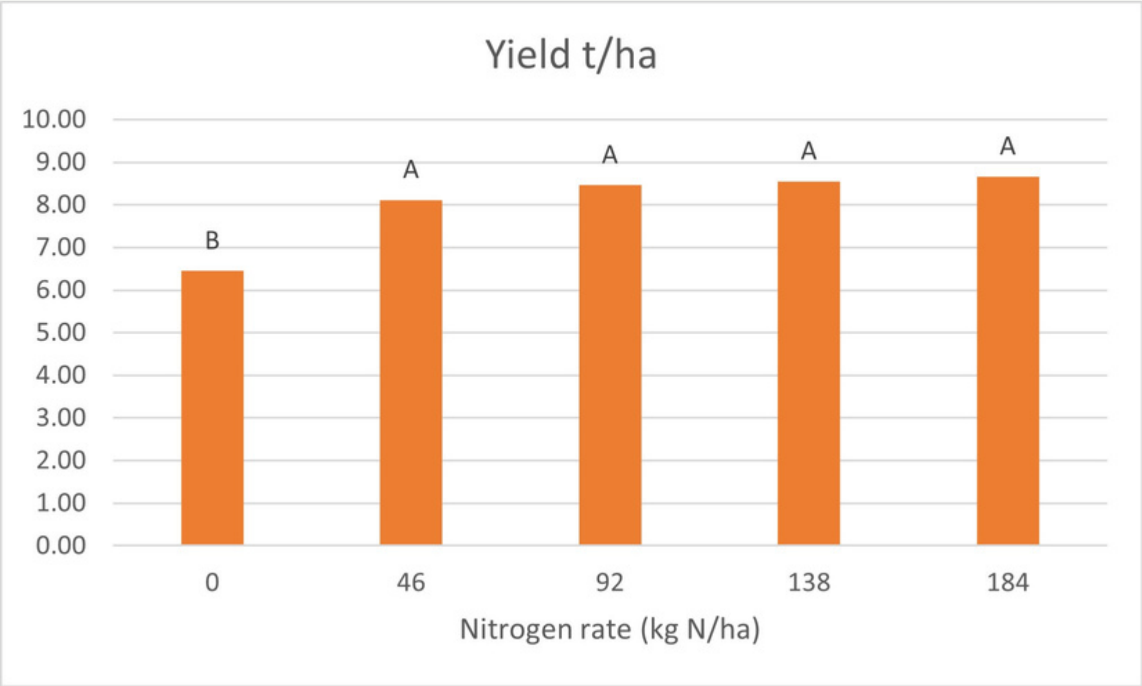

Figure 3. Grain Yield

From figures 2 and 3 we can see that the addition of nitrogen has had a significant impact on grain yield, with a yield increase of 1.66t/ha from 0 kg N/ha to 46 kg N/ha. With additional nitrogen we continued to slight yield increases as the rate of nitrogen increased, however, this was not significant.

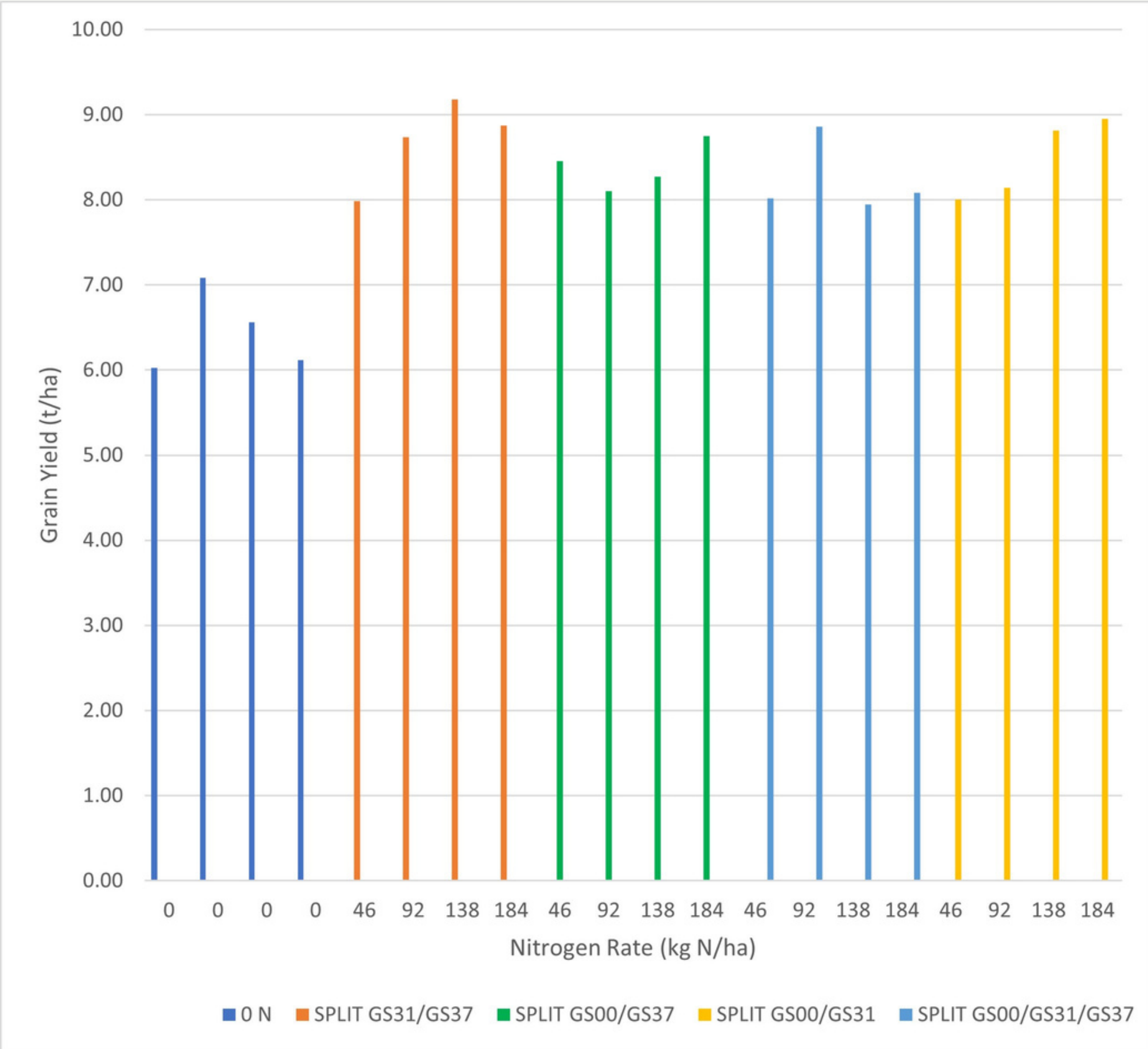

Figure 4 – grain yield with different timings of application

Figure 4 above shows the different timings of application of nitrogen and the different rates. This again highlights that the crops were responsive to the addition of nitrogen compared to the nil plots.

When applying nitrogen split between GS31 and GS37 we found that the yields to be highest when applying 138kg N/ha. This was significantly higher than the application of 42kg N/ha whereas it was not significantly higher that the rate of 92kg N/ha. We did not see any yield advantages to going to the top rate of 184kg N/ha at these timings.

When we split the applications between GS00 and GS37, we did not see any significant differences between the different rates.

Applications split between GS00, GS31 and GS37 we found the best results were achieved when applying 92kg N/ha. This was significantly higher than the application rate of 42kg N/ha. Surprisingly we did not see any additional yield responses for the higher rates (138kg N/ha and 184kg N/ha) with this application split.

The final timings were at GS00 and GS31. We found here that yield increase in line with the amount of nitrogen applied. The greatest yield was achieved with the addition of 184kg N/ha. This was significantly higher than the rate of 42kg N/ha and 92kg N/ha, however not significant compared to the rate of 138kg N/ha.

Table 2. Retention, screenings, and protein results

Total N kg/ha Applied	Retention % > 2.5 mm screen		Screenings < 2.2 mm screen		Protein %	
184	97.07	a	0.48	c	12.7	e
138	97.55	a	0.43	bc	12.0	d
92	98.09	b	0.32	ab	11.2	c
46	98.62	c	0.22	a	10.4	b
0	98.75	c	0.23	a	9.5	a
Mean	*98.02*		*0.34*		*11.1*	
P Value (0.05)	<.001		<.001		<.001	
LSD	0.48		0.12		0.39	
CV%	0.3		0.6		0.7	

With the addition of increasing rates of nitrogen, we were able to see some significant impacts on grain quality characteristics, as seen above in table 2.

The retention of the barley decreased with increasing rates of nitrogen; we noticed a significant decrease in retention from 46 kg N/ha applied to 92 kg N/ha applied. We than observed another significant decrease when going from 92 kg N/ha applied to 138 kg N/ha applied. Whilst these were significant results, the Grain Trade Australia (GTA) receival standards for barley do not specify a minimum standard for feed grade barley and malt barley has a minimum requirement of 70% by weight.

Screenings also increased with increased rates of nitrogen per ha. We seen a significant increase in the level of screenings between 46 kg N/ha and 138kg N/ha. Whilst we have seen an increase in the level of screenings is still below the maximum GTA standards for Malt and feed barley.
For every rate increase in nitrogen, we seen a significant increase in the amount of protein in the grain. This highlights that the crop was very responsive to additional nitrogen and was able to efficiently turn it into grain protein.

Trial Inputs (all plots)

	Date	Product	Rate/ha
Seed Dressing	20-May-21	Systiva®	150 ml / 100 kg seed
	20-May-21	Gaucho® 600 Red Flowable	240 ml / 100 kg seed
Herbicide	20-May-21	Roundup PowerMAX®	2.0 L
	20-May-21	Goal™	75 ml
	20-May-21	Overwatch®	1.25 L
	10-Aug-21	Starane® Advanced	300 ml
	10-Aug-21	Triathlon®	750 ml
Fungicide	10-Aug-21	Aviator® Xpro®	400 ml
	16-Sep-21	Aviator® Xpro®	400 ml
Insecticide	20-May-21	Lorsban® 500 EC	500 ml
	10-Aug-21	Alpha Duo	125 ml
	16-Sep-21	Karate Zeon®	30 ml
Pesticide	20-May-21	METAREX®	5 kg
	20-May-21	MOUSEOFF® Zinc Phosphide Bait	1 kg

Frost Events

The trial experienced frost events on the following dates: -1.5 °C on Jul 9, -2.4 °C on Jul 10, -0.2 °C on Jul 21, -0.6 °C on Aug 27, -0.7 °C on Sep 5, -1.2 °C on Sep 14, -0.9 °C on Sep 16, -1.8 °C on Sep 26, -0.1 °C on Oct 10, -2.1 °C on Oct 11, -1.2 °C on Oct 12, -0.3 °C on Oct 25, -0.5 °C on Oct 30

Heat Events

This trial experienced extreme heat conditions on the following dates: 33.7 °C on Nov 2, 34 °C on Nov 5, 34.6 °C on Nov 18, 33.5 °C on Nov 22, 33 °C on Nov 24, 33.9 °C on Nov 28, 37.6 °C on Nov 29, 39.9 °C on Nov 30, 40.2 °C on Dec 1

Conclusion

Following a lucerne crop, the crop was responsive to additional nitrogen inputs. With a background soil nitrogen level of 66kg N/ha, we were able to maximise yield with only the addition N. We see a significant improvement in yield with the application of 46kg N/ha, however, additional to this seen yield improvements, which were not significant.

The addition of nitrogen also influenced grain quality. The most dramatic response was the increase in grain screenings with the increasing rates as well as the increasing grain protein with the increased rates of nitrogen.

We struggled to find any standout significant differences with the application timings. Whilst not significant, the plots that received nitrogen at GS00 and GS31 did appear to perform better and showed greater levels of vigour.

Acknowledgements

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GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

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