NITROGEN RATES IN NORTH CENTRAL VICTORIA

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TAKE HOME MESSAGES

- Urea rates of 90, 160 and 200kg/ha resulted in the highest wheat yield.
- Increasing urea from 60 to 90kg/ha resulted in an extra 0.3t/ha of wheat yield.
- Trying to grow high protein wheat, from an economic perspective was not worthwhile in 2020 at Pyramid Hill (south).

BACKGROUND

Over the past 20 years there has been a general shift in farming systems away from legume pastures and more towards grain legume/canola/cereal rotations. This consequently leaves less residual nitrogen (N) in the soil and can create challenges for managing cereal and canola crops in terms of matching N supply to crop requirements.

N fertiliser increases production costs and can increase risk associated with it due to the uncertain nature of rainfall. Hay in the rotation takes out higher amounts of N where limited legumes are grown all N must come from bagged fertiliser. It is known that Australian wheat yields, on average, are half what they could be for the rainfall received due to N deficiency (Hochman *et al*. 2017). Decision making tools can be used to assist in determining how much N to apply in season. These tools include Yield Prophet®, Yield Prophet lite, Sadras and Angus and French and Schulz water-use efficiency calculations for yield potential and matching N inputs to the potential yield. The difficultly in N management is the complexity in understanding the seasonal conditions such as pre-sowing soil water, rainfall in-crop and soil N that is available to the crop.

AIM

To determine the optimum nitrogen fertiliser rate to achieve the maximum wheat yield in the North Central region.

PADDOCK DETAILS

Location:	Pyramid Hill South
Crop year rainfall (Nov-Oct):	399mm
GSR (Apr-Oct):	281mm (decile 3)
Soil type:	Clay loam
Paddock history 2019:	Wheaten hay

TRIAL DETAILS

Crop type/s:	Scepter wheat
Treatments:	Refer to table 1
Target plant density:	130 plants/m^2
Seeding equipment:	Knife points, press wheels, 30cm row spacing
Sowing date:	26 May 2020
Replicates:	Four
Harvest date:	26 November 2020
Trial average yield:	2.6t/ha

TRIAL INPUTS

Urea application:	16 July 2020 @ GS15/22
Rates:	Refer to Table 1.

Weeds, pests and diseases were controlled according to best management practice.

METHOD

A randomised block N trial was established at the Pyramid Hill South trial site (Table 1). The trial was sown with the BCG plot seeder. Yield and grain quality indicators were assessed to determine treatment differences. Starting soil N at the site was 56kg N/ha to a depth of 1m and pre-sowing there was 33mm of plant available water (mm).

The target yield was based on a long-term wheat average yield of 2.3t/ha. N rates were then calculated based on assuming 40kg N/ha to produce 1t/ha of grain (at 11 percent protein) and taking into account soil mineralisation. The other five treatment target yields were 1.2t/ha, 1.5t/ha, 2t/ha, 2.3t/ha, 3.2 t/ha and 3.7t/ha, N rates were calculated for these yield potentials and then top-dressed accordingly.

Mitiamo, APW wheat price of $257.5/t and ASW price of $246/t on 16 December 2020 were used to calculate a partial gross margin. (A urea price of $550/t has been used to calculate cost).

Table 1. Urea and nitrogen application rates (kg N/ha) used in the trial.

Treatment	Urea rate (kg/ha)	Nitrogen rate (kg N/ha)
1	0	0
2	20	9
3	60	28
4	90	41
5	160	74
6	200	92

RESULTS AND INTERPRETATION

Seasonal conditions:

The season started with optimism as autumn rainfall received was well above average. This was however followed by a dry winter period (June and July) which saw many crops progress through growth stages without the ability to uptake the applied N. At the time of top-dressing the wheat was at GS15/22 (mid-tillering). In season rainfall following topdressing (16 July) was 17mm, which fell over 22 days in small amounts of all less than 1mm, except for August 7 which there was a significant fall of 14mm. The long-term average rainfall for July at Mitiamo is 39mm. July's rainfall was 15mm. This may have had an influence on the incorporation of N in the soil and consequently in crop uptake. Also, the growth stage of the crop being near GS30 means the ability to influence tiller number was limited.

Despite seasonal conditions with a relatively dry June/July, N treatments resulted in differences in wheat grain yields. The 90, 160, 200kg/ha urea rates yielded the highest with a mean yield of 2.9t/ha (Figure 1). These three treatments had a significantly higher yield than the three lowest rates of 0, 20 and 60kg urea/ha. The yield difference between the 90 and the 60kg/ha urea treatments was 0.3t/ha.

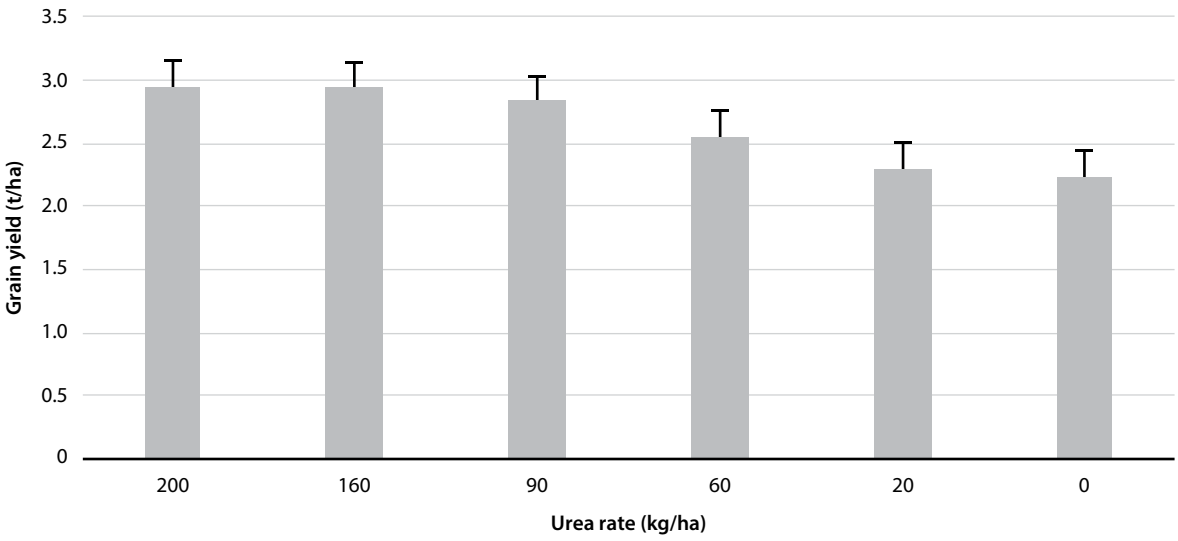

Figure 1. Mean grain yield (t/ha). Error bars indicate significant difference (LSD). Stats: P<0.001, LSD 0.2t/ha, CV 5.4%.

Grain quality of test weight and screenings achieved highest grade requirements. There were some differences between treatments (Table 2) but not all treatments were influenced by receival grade. There were differences in grain protein, with protein increases mirroring urea rates. Despite high levels of N application at the top rates, grain quality still only reached a maximum grade of APW at the highest N rate. All other treatments were classified as ASW. This could be due to the soft cooler spring which may have limited increases in protein. Grain yield removed on average 42kg N/ha from the soil, with higher yielding treatments removing more N from the soil.

Table 2. Grain quality characteristics for the nitrogen treatments and kg N/ha removed.

Treatment (kg urea/ha)	Protein (%)	Screenings (%)	Test Wt.	Kg N/ha removed
0	7.8	3.2	81.7	31
20	8.2	3.6	81.8	33
60	8.8	3.0	82.6	39
90	9.3	2.7	82.9	46
160	10.0	2.4	82.9	52
200	10.7	2.5	82.3	55
Sig. diff.	**<0.001**	**<0.001**	**<0.001**	**<0.001**
LSD (P=0.05)	**0.4**	**0.3**	**0.5**	**3**
CV%	**2.7**	**7.5**	**0.4**	**5.2**

COMMERCIAL PRACTICE AND ON-FARM PROFITABILITY

Growers need greater understanding and confidence that N applied, which may not be utilised, has a low risk of being lost (which is unlikely unless leaching by heavy rains occurs). While the risk of haying off is often high (dependent on starting soil N), research carried out by Hunt et al. 2019 suggests that in low rainfall environments with heavy soils, applied N surplus to crop requirements is available for use by subsequent crops and rarely is haying-off actually observed.

A typical wheat yield for the region is 2.5t/ha so based on a rule of thumb: 40kgN/ha is required to grow 1t/ha wheat, 100kg of N/ha is needed. Soil mineralisation and soil test results need to be subtracted from this to calculate the amount to apply. This trial result shows an upside to increasing N amount by extra yield gained by increasing the rate to 90kg/ha urea as this gave an extra 0.3t/ha in yield.

Applying some N early in the season can also help to mitigate the risk of limited in-season winter rain to adequately wash N in. This however is not the case in every year as sometimes anticipated winter and spring rainfall is not always received.

The results highlight a yield response from the extra applied N in the 90, 160 and 200kg urea/ha treatments. However, when this is extrapolated out to gross return from the wheat grade achieved there are differences in return ($/ha). A partial gross margin ($/ha) has been calculated which is income remaining after N costs are deducted (Urea $550/t and $5/t spreading costs).

The extra N applied to gain a grade quality change was from the 90kg/ha urea to the 200kg/ha urea treatment, this resulted in an extra $61/ha gross return (Table 3). The 90kg/ha urea treatment however did not result in more profit (compared to the 200kg/ha urea treatment), as the partial gross margin gave the same return of $645/ha. Trying to grow high protein wheat was not profitable in 2020. The 90kg/ha urea treatment resulted in an extra $54/ha compared to the 60kg/ha urea treatment.

Table 3. Wheat quality achieved and gross return ($/ha) and partial gross margin ($/ha).

Treatment (Urea kg/ha)	Grade achieved	Gross Return ($/ha)	Partial gross margin ($/ha)
0	ASW	550	545
20	ASW	566	550
60	ASW	629	591
90	ASW	699	**645**
160	ASW	724	631
200	APW	**760**	**645**

REFERENCES

Hochman Z., Gobbett DL. and Horan H. (2017) Climate trends account for stalled wheat yield in Australia since 1990. Global change biology Vol 23, pp 2071-2081.

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