3.4.10 Nitrogen response trial - Inverleigh, Vic

Location:
Inverleigh Research Site.

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Background/Aim:
This trial was aimed at answering some important questions in relation to nitrogen fertiliser application, these questions are: How much, what product and when? This trial consisted of 10 treatments, all treatments received 100 kg MAP/ha at sowing but thereafter the nitrogen rate, timing and product was varied as per table 1.
Seasonal rainfall variability, soil N reserves and cultivar selection are the confounding factors in terms of N applications, along with the cost of fertiliser and application. Table 2 is aimed at breaking down the costs of N application and the return on investment to aid decision making.

Paddock History:
200: Wheat, 2008: Canola

Soil Type: Sandy clay loam

Soil Nutrients:
N = 16mg/kg (0-10cm) + 4.1mg/kg (10-60cm)
P = 43mg/kg (Colwell)
K = 0.5 Meq/100g
S = 11mg/kg
pH ($CaCl^2$) = 5.8.

Take home messages:
- A mean yield of 5.97 t/ha was achieved for the 2009 nitrogen response trial at the Inverleigh site.
- There were no significant differences in yield across the trial.
- The variety used for this trial was Preston.
- Grain quality achieved AGP1 for all treatments with low test weights and low protein levels the contributing factors.
- Fertilizer prices at time of application were rounded to $450/t urea, and $500/kL UAN. Whilst the price of fertiliser has almost halved in the past year they are still very significant in terms of ROI (Return on Inestment)
- Only two of the nine fertiliser treatments yielded a monetary benefit.

Trial information:
Trial design consisted of a replicated randomised block design using 4 repetitions. The crop was treated using 'district practice' for fungicide and herbicide treatments. Plot lengths were 12 metres long and 1.45m wide.

Rainfall:

Avg. Annual:	483.9mm, Sheoaks 1991-2009
Avg. G.S.R.	386.5mm, Sheoaks 1991-2009
2009 Total:	502.0mm, Inverleigh Research Site
2009 G.S.R.	April – October = 317.0mm[1]
	(Inverleigh Research Site; 73mm below average)

[1] Yield Potential: 1/3 of Dec (77mm), Jan (2mm) & Feb (4mm) with monthly totals above 20mm + ½ March (36mm) rainfall when total above 20mm + ((April – October rainfall) – 117mm*) x 20kg/mm/ha. In total December-March adjusted rainfall to stored soil water = 43.6mm, plus April-October = 317.0mm, minus evaporation factor of 117mm* => 243.6. Therefore, for Inverleigh, the Wheat Variety Trial water limited yield should be 4.87t/ha, or 243.6mm x 20kg/mm/ha.
*Kirkagaard 2009, Evaporation intercept adjustment for a clay loam.

Treatment list:
Preston wheat., various rates of Urea and UAN at different timings. Measurements included yield and grain quality components, including protein, test weight, screenings and resulting classification.

Sowing date: 7th May 2009

Harvest Date: 24th December 2009

Sowing rate:
Seeding rate based on seed size with a desire to establish 160 plants/m^2

Fertiliser:
100kg/ha MAP at sowing, Urea and Easy N as per protocol

Fungicides:
16/9 Prosaro @ 200ml/ha + Hasten @ 1%

Herbicides:
- 6/5/09 Sprayseed @ 1.2L/ha + Triflur X @ 1.50L/ha Roundup Pmax @ 1.5l/ha, Striker @ 150ml/ha
- 11/5/09 Dual Gold @ 250ml/ha + Diuron @ 500ml/ha
- 16/06/09 Axial @ 350ml/ha + Precept @ 1.20l/ha + Lontrel @ 150ml/ha + Adigor @ 0.5%

Tillage type:
This trial was seeded with the SFS cone seeder using 2.5cm knifepoints.

Diseases:
Minor pressure of stripe rust was observed for the 2009 season.

Results and discussion:
This trial is an example of just how difficult it can be to make a decision in regard to nitrogen fertiliser applications during a season. There were no significant yield differences noted in this trial, however this limited result still has something to tell us in terms of risk management, at the very least how to reduce our losses if not increase our gains.

The control treatment received only 10kg N/ha at sowing and two other treatments received only 50kg N/ha at GS31/33 in Urea and UAN respectively, the rest of the treatments received 90kg N/ha at various timings. Our results from the 10 treatments found no significant difference in yield and no significant difference in test weight. There were significant differences in protein levels, with the untreated (no fertilizer) showing the lowest protein, along with the two treatments that only received 50kg N/ha. Screenings displayed significant differences, although all apart from one treatment were below the 5.0% requirements for quality standards.

There are several conclusions that we can make from this information. The similar yields could have been brought about by the sudden hot period in November, thus ending the growing season suddenly. Generally, however, you would expect somewhat higher levels of protein in this situation due to a yield-protein dilution effect and it appears what we have here are quite low protein levels overall. The zero and 50kgN/ha results show significantly lower protein levels, indicating the importance of available nitrogen to boost protein levels, even in a year with a sudden finish.

Amongst the treatments similar yields, similar test weights and relatively alike screenings results may indicate that what we are seeing is a robust plant response to severe conditions. Choice of cultivar is obviously an important decision. In this case Preston, through not statistically displaying the effects of different amounts, types and timings of nitrogen, may be limiting the impact of a severe end to the season. This robustness is displayed in the very uniformity of the results.

A yield advantage of 520kg/ha was observed for the highest yielding treatment over the control. This also was the only treatment to receive a late application of Urea at GS39. The yield advantage needs to be examined in conjunction with the kg of Grain gained per kg of N applied column and the return on investment column. The kg of Grain gained is simply that, a calculation showing how much extra grain above the control was yielded in relation to the amount of nitrogen applied. In this case the top ROI result was achieved by the 40kgN/ha applied as Urea at GS 31/33 treatment with a 21.76% return on investment over the control. Noticeably poorer ROI results were achieved by the UAN applications as this was somewhat more expensive per unit of N. The negative ROI results indicate that in these situations it would have been better to apply no fertiliser at all as there was not enough yield benefit to cover the cost of the fertiliser. This further emphasises the importance of fertiliser applications and decisions about what to use and when. In this trial, even relatively small increases in fertiliser prices would have caused the entire ROI column to return large negative returns, that is, apart from the control.

Table 1: Grain yield, corrected to 12.5% moisture. Quality analyses: including protein, test weight, screenings & resulting grading.

Nitrogen Strategy								
GS00	**GS31/33**	**GS39**	**Total N**	**Yield (t/ha)**	**Protein (%)**	**Test Weight (kg/hl)**	**Screenings (%)**	**[1]Resultant Grading**
10 MAP	0	0	10	5.77	9.92	69.79	2.3	AGP1
10 MAP + 20 Urea	60 Urea	0	90	6.16	11.17	69.57	6.2	AGP1
10 MAP + 40 Urea	40 Urea	0	90	5.86	12.01	69.22	3.9	AGP1
10 MAP	40 Urea	0	50	6.08	10.26	69.63	4.8	AGP1
10 MAP	40 Urea	40 Urea	90	6.29	11.36	69.96	1.6	AGP1
10 MAP	80 Urea	0	90	5.70	11.10	69.59	5.0	AGP1
10 MAP + 20 Easy N	60 Easy N	0	90	6.13	10.69	72.77	3.2	AGP1
10 MAP + 40 Easy N	40 Easy N	0	90	5.79	11.34	69.23	3.7	AGP1
10 MAP	40 Easy N	0	50	5.81	10.02	70.11	4.0	AGP1
10 MAP	80 Easy N	0	90	6.08	11.28	71.81	3.3	AGP1
Mean				**5.97**	**10.91**	**70.17**	**3.8**	
LSD (p=0.05)				**0.8114**	**0.575**	**3.329**	**2.13**	
CV				**7.93**	**5.26**	**3.18**	**37.52**	

[1]Quality parameterisation is based on 2008-2009 NACMA Wheat Standards and should be used as a guide only.

Table 2: Grain quality analyses, including protein, test weight & screenings that contribute to final economic analysis of variety performance on a GM/Ha basis.

Nitrogen Strategy								
GS00	**GS31/33**	**GS39**	**Total N**	**Yield (t/ha)**	**[1]Yield Advantage (kg)**	**[2]kg Grain gained / kg N applied**	**[3,4]N ROI % over Control**	**[4]Gross Margin ($/ha)**
10 MAP	0	0	10	5.77	0	0.00	0.00	629
10 MAP + 20 Urea	60 Urea	0	90	6.16	390	4.33	-14.07	617
10 MAP + 40 Urea	40 Urea	0	90	5.86	87	0.97	-80.83	558
10 MAP	40 Urea	0	50	6.08	307	6.14	21.76	640
10 MAP	40 Urea	40 Urea	90	6.29	520	5.78	14.58	642
10 MAP	80 Urea	0	90	5.70	-67	-0.74	-114.76	568
10 MAP + 20 Easy N	60 Easy N	0	90	6.13	360	4.00	-34.82	592
10 MAP + 40 Easy N	40 Easy N	0	90	5.79	23	0.26	-95.84	527
10 MAP	40 Easy N	0	50	5.81	37	0.74	-87.94	577
10 MAP	80 Easy N		90	6.08	307	3.41	-44.41	582
Mean				**5.97**				
LSD (p=0.05)				**0.811**				
CV				**7.93**				

[1]Yield Advantage determined as kg above or below control treatment yield.
[2]Kg Grain gained/ kg N applied shows how many kg of grain is gained per kg of Nitrogen applied.
[3]N ROI % over control determined by (Yield advantage multiplied by grain price ($194 AGP1) minus the dollars spent on Nitrogen as a percentage)
[4]Prices for grain were taken as a spot price on the day of Harvest supplied by Riordan Grains; AGP1 =$194/t. Nitrogen cost estimated at $450/t urea, and $500/kl UAN. Higher prices will reduce the ROI dramatically.

Summary:
It is important to determine the potential economic benefits of nitrogen fertiliser before application and what the break even points are. Consideration must be made for yield potential, cost of nitrogen and price of grain. Whilst this trial may on initial examination appear to have not shown a large amount of conclusive information in terms of yield or quality what it does show is how some decisions may limit losses if not increase gains in certain years. There are clear differences observed in gross margin and return on investment. A major point to be taken from this trial is that in only two out of nine examples (Treatments 4 &5) would a farmer have made a monetary gain by applying nitrogen fertiliser. With only a small increase in fertiliser prices there would be a dramatic shift in the ROI making all treatments an overall loss other than the control. Obviously this has to be taken on a year to year basis; however in a year such as this trial modelled the decision to not apply nitrogenous fertiliser would be the right one.