Wheat Canopy Management Trial - Wimmera

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The following trial is part of a GRDC funded project (SFS 00006) examining the role of disease management and canopy management in cereal crops of southeast Australia. The trial had the aim of examining the value of canopy management in the Wimmera.

Summary

- If measured purely in terms of yield, nitrogen (N) application was not cost effective in this trial, with 50kg/ha N producing an average yield increase of approximately 0.2t/ha.
- However, when measured in terms of both protein and yield there was a small economic advantage to 50kg/ha N applied at mid tillering. At 100kg/ha N despite higher protein, yield was reduced and the higher dose was not cost effective
- There was no yield disadvantage on this Wimmera clay to delaying all of the nitrogen to GS30 (start of stem elongation) compared to earlier timings (pre-sown and mid tillering)
- The 50 kg/ha N dose at GS15 was the most cost effective treatment - whilst yields were no higher than those in which urea was pre-drilled, protein levels were significantly higher.
- Early nitrogen timing produced more tillers/m^2, ears/m^2 and larger canopies than later timings, however tiller death per m^2 was much greater post stem elongation with these early applications.

Background

Of those factors that may be controlled by the grower, nitrogen management and plant population are the two key ingredients that dictate the size and structure of the crop canopy with cereal crops. Historically, a great deal of emphasis has been placed on upfront nitrogen applied in the seedbed. In seasons with adequate growing season rainfall, where yield potential is relatively high, the crop can make use of the canopy created by this early nitrogen timing. In seasons with limited rainfall, however, the crop does not have the capacity to fill the grain in all the shoots created, leading to poor yield and quality.

Where canopy management has been adopted elsewhere in the world, it has usually been associated with high rainfall zones and has led to growers adopting later applications of nitrogen, very often fed to thinner crops. So would it work here in Australia where lack of rainfall and soil type makes crop nitrogen uptake of top dressings much more variable?

Many other BCG trials reported in the 2004-05 Crop and Pasture Production Manual link to this project. If the grower is to be more dependent on top dressed nitrogen, we need to know how different forms of nitrogen fertiliser cope with seasonal conditions when applied as a topdressing, i.e. are some nitrogen forms more efficient than others under our conditions.

Last years results on later N topdressing were encouraging, albeit set against a wetter period for uptake in September. This year's work repeats the work from last year but with the added variable of nitrogen rate.

Methods

Mitre wheat was sown at Lubeck on 12th of June at a plant population of 151 plants/m^2. The crop was treated with standard inputs, with the exception of nitrogen fertiliser which was applied in accordance with the treatment list in Table 1.

Table 1. Nitrogen (urea) Timing and rate (kg/ha N) applied to Mitre wheat – Lubeck

Treatment Timing	Growth Stage Description
Untreated	No nitrogen applied
100% N pre-sowing -12th June	All nitrogen applied pre-sowing
100% N GS15/23 – 12th August	All nitrogen applied at 5-6 leaf stage (mid tillering)
100% N GS30 – 6th September	All nitrogen applied at start of stem elongation
100% N GS45 * - 6th October	All nitrogen applied at booting
50% N pre sowing; 50% N GS30	50% of N applied at pre- sowing and 50% at start of stem elongation

At each timing nitrogen was applied at two different rates: 50 and 100 kg/ha N, with the exception of the GS45 treatment timing*, in which nitrogen was applied only at 100kg/ha N. Soil moisture was not a constraint for N application uptake with enough rainfall ensuring uptake after each application.

The trial was assessed for tiller numbers, head counts, canopy size, disease, yield and grain quality. Soil tests revealed a low soil N reserve at sowing of 47 kg/ha over a depth of 0-60 cm on this Wimmera clay site following a canola crop in 2003.

Results

Yield

At Lubeck there was a small yield response (0.2 t/ha) to nitrogen fertiliser at the 50 kg/ha N nitrogen rate but a slightly negative effect from 100kg/ha N (Table 2 and Figure 1). Growing season rainfall at the site was well below the average of approximately 320mm with 210mm falling between April and October. The site was under severe moisture stress from mid September until early November with only 7.5mm falling in October.

Table 2. Yield response (t/ha) to nitrogen fertiliser at two rates – mean of four nitrogen timing treatments (excluding GS45 timing)

	No nitrogen	50 kg/ha N	100 kg/ha N
Yield (t/ha)	2.46	2.64	2.41
Difference to control	0	+0.18	-0.05

The application of 50kg/ha N caused significantly higher yields at any one time of application compared to the 100kg/ha rate (except at GS30 where the increase was not significant) (Figure 1). This difference appears more pronounced at the earlier application timings. There was no difference in yield when 50kg/ha N was applied, regardless of when it was applied.

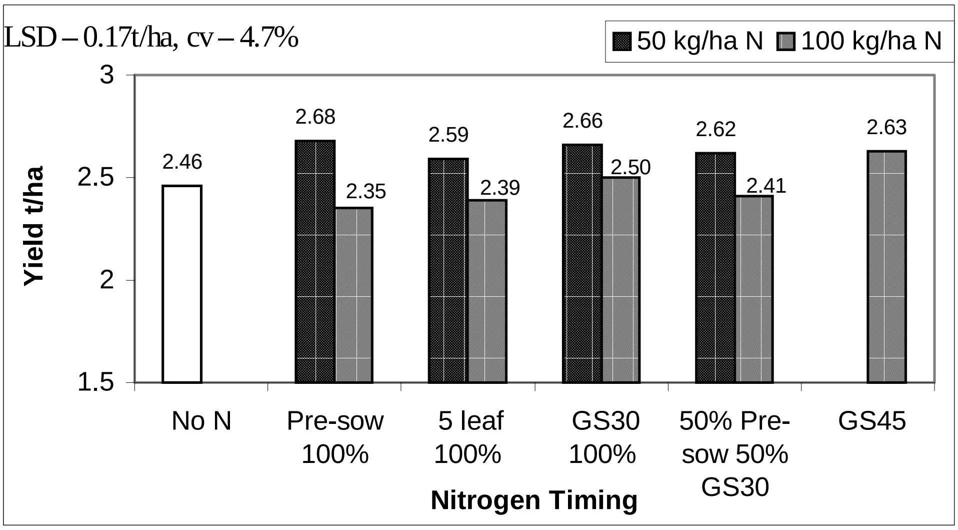

Figure 1. Yield response to individual nitrogen timings and rates (t/ha)

Protein

Protein levels were significantly increased by the addition of nitrogen, with the highest nitrogen rates giving the highest protein levels (Table 3).

Table 3. Protein response (%) to nitrogen fertiliser at two rates – mean of four different nitrogen treatments (excluding GS45 timing).

	No nitrogen	50 kg/ha N	100 kg/ha N
Protein %	9.0	11.4	13.4
Difference to control	0	+2.4	+4.4

At 50 kg/ha N there was a significant advantage to later nitrogen application in terms of protein content, however this was not the case at the higher nitrogen level (Figure 2).

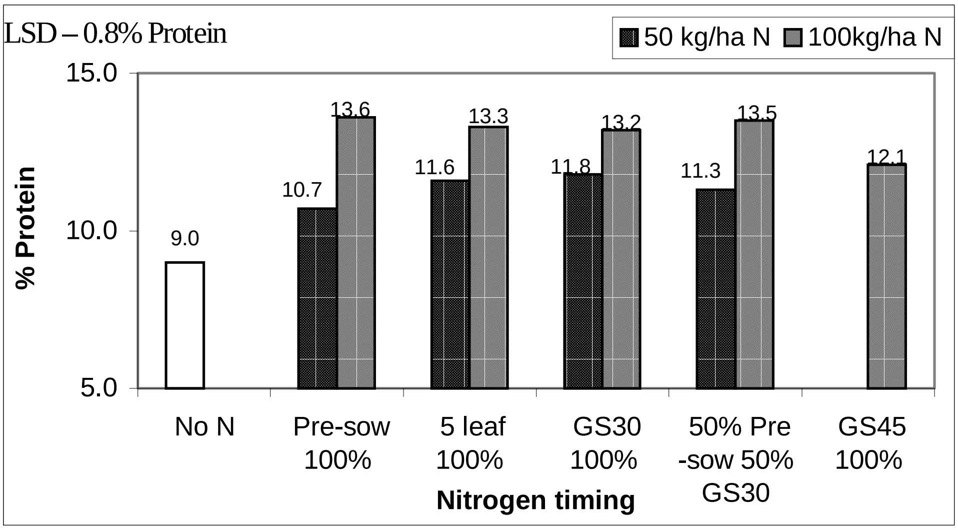

Figure 2. Protein response to individual nitrogen timings and rates

Screenings

For all treatments, screening percentages were below 2% in the 0.6 – 1.3 % range. There were no significant differences due to treatments.

Crop Structure

There was little or no correlation between ear count and yield (R^2= 0.23) and a suggestion that the highest tiller numbers gave the lowest yields (correlation R^2= -0.51). Applying nitrogen earlier created more tillers/m^2 and heads/m^2, however the degree of tiller loss was much greater with these treatments (Table 4).

Table 4. Influence of nitrogen rate and timing on crop structure and yield (tillers/m^2, ears/m^2, ears per plant, tiller loss/m^2 and t/ha)

Nitrogen treatment		**Crop structure assessment**				
Rate kg/ha N	**Timing**	**Tillers /m^2**	**Ears/m^2**	**Ears /plant**	**Tiller loss/m^2**	**Yield t/ha**
0		493	284	1.74	210	2.46
50	100% Pre -sow	593	325	1.83	268	2.68
50	100% GS15/23	549	329	1.67	220	2.59
50	100% GS30	468	309	1.52	160	2.66
50	50% Pre-sow 50% GS30	503	323	1.56	180	2.62
100	100% Pre -sow	638	312	2.05	326	2.35
100	100% GS15/23	607	300	2.02	307	2.39
100	100% GS30	473	355	1.33	117	2.50
100	50% pre-sow 50% GS30	610	328	1.86	282	2.41

Interpretation

With relatively low soil nitrogen reserves (47kg/ha N) on this Wimmera clay, there was no yield disadvantage from applying all of the N at GS30. While the yield at 50kg/ha N was no greater than for the same amount of N pre-sown, the protein was significantly higher. The work also endorses the fact that in drier seasons excess nitrogen can be detrimental, especially when applied upfront.

Whilst rainfall for uptake is still a key ingredient for the success of in-crop nitrogen timings, this work should give greater confidence to those who wish to leave a greater proportion of N application until later in the season. This delayed timing gives a better opportunity for matching yield potential to the seasons potential and hence the need for nitrogen. It also allows us to make much greater use of predictive models such as APSIM, since just prior to the GS30 nitrogen application in this trial APSIM was already predicting a 50% probability of only 2t/ha and no more than 3t/ha.

The significant lift in yield and protein from extremely late nitrogen application at GS45 (booting) also illustrates that there may be opportunities to respond to an extremely late increase in yield potential.

In terms of yield alone, it was not economic to have applied nitrogen in this trial. However, when protein was included in the calculation the outcome changed. The zero N plots delivered at 9.0% protein – several of the N treatments reached either H1 or H2 grade for which there is a significant bonus paid.

Only one treatment had a higher margin than the zero N treatment ($339/ha) which was the 50kg N applied at the five leaf stage ($371/ha) (Table 5).

Table 5. Gross income $/ha for Mitre wheat after nitrogen costs (not including application cost) based on Graincorp cash price delivered Marmalake (24/1/05).

N application	Yield	Protein	Bin Grade	Gross income	Gross income – urea cost
No N	2.46	9.0	APW1	339	339
50kg N Pre sowing	2.68	10.7	APW1	382	332
100 kg N Pre sowing	2.35	13.6	H1	391	291
50kg N GS15	2.59	11.6	H2	421	371
100kg N GS15	2.39	13.3	H1	395	295
50kg N GS30	2.66	11.8	APW1	386	336
100kg N GS30	2.5	13.2	H1	412	312
25kg Pre sowing, 25kg GS30	2.62	11.3	APW1	379	329
50kg Pre sowing, 50kg GS30	2.41	13.5	H1	400	300

Results based on 1% screenings for all treatments. Payments paid on Bin Grade and increments for protein and screenings. Cost of nitrogen as urea - $1/kg N.

Commercial Practice

At current low commodity price for wheat, the high price for urea and the uncertain outlook for the 2005 season it is advisable to be very conservative with pre-sowing nitrogen.

In the Wimmera, sufficient N should be applied to ensure the crop is not nitrogen deficient during the tillering phase (from sowing up to GS30) and the rest of the N should be top-dressed (or applied as a foliar application) when the season outlook is clearer and N requirements can be more accurately assessed.

Soil testing for available soil moisture and nitrogen pre-sowing will be an excellent tool this year for ensuring that money on fertiliser is well spent, and spent at the right time.