Barley 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 environment.

Summary

- Growing season rainfall at this site was well below average (approximately 350mm) with 264mm for April - November. October was particularly dry with only 7.5mm
- Against this background, barley treatments in the trial yielded in the range of 1.44 – 1.89 t/ha with nitrogen addition serving only to reduce yield, reduce retention and increase screenings
- Whilst yields were not significantly reduced in every individual case the negative influence of applied nitrogen on screenings and retention was always significant
- Nitrogen rates of 100kg/ha N were significantly inferior to lower nitrogen rates of 50 kg/ha N
- With a grain protein of almost 9% and the highest retentions and lowest screenings, the zero nitrogen treatments were the most profitable in terms of malting barley.
- All the nitrogen treatments except pre sow N at 50 kg/ha N produced protein levels above 12%, with screening levels ranging from 9 to 27%

Background

Of those factors, which are under the grower's control, 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, however in seasons with limited rainfall the crop does not have the capacity to grain fill all the shoots created, leading to poor yield and quality.

As a technique, canopy management was developed primarily for the autumn sown wheat crop, yet the principals of avoiding overly thick vegetative crops could just as easily be applied to barley. The exception is of course malting barley which whilst requiring the correct canopy structure to avoid haying off, lodging and increased disease pressure also requires the grain protein levels to be within a certain range. As already seen in the wheat results delaying nitrogen creates higher protein levels in the resultant grain, thus whilst there maybe advantages to delaying N in terms of canopy structure it could potentially push protein levels higher than required, making nitrogen timing extremely important. In last year's trials there was evidence that the barley trials, which received approximately 20 kg/ha N, were underfed. In addition nitrogen timing last season had no significant effect on barley yields in the Mallee trial with all N upfront yielding the same as N applied at GS30-31.

Methods

Gairdner barley was sown at Lubeck on 12th of June at a plant population of 106 plants/m2 with a 12m commercial seeder. 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 Gairdner at Lubeck

Treatment Timing	Growth Stage Description
Untreated	No nitrogen applied
100% N pre-sowing -12th June	All nitrogen applied pre sowing of the crop
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 GS49 * - 6th October	All nitrogen applied at 1st awns emerging
50% N pre sowing; 50% N GS30	50% of N applied at pre- sowing and 50% at start of stem elongation

All nitrogen timings were then applied at 2 different rates, 50 and 100 kg/ha N with the exception of the GS49 treatment timing*, which was only applied at 100kgN/ha. Soil moisture was not a constraint for N application uptake with following rainfall ensuring uptake.

The trial was assessed for tiller numbers, head counts, canopy size, disease and yield and quality. Soil tests revealed a low soil N reserve at sowing of 47 kg/ha N over 0-60 cm on this Wimmera clay site following a wheat crop in 2003 and canola in 2002.

Results

Yield

At Lubeck there was no yield response to nitrogen fertiliser with both 50 kg/ha N and 100kg/ha N nitrogen rate giving a negative yield effect (Table 2).

Table 2. Yield response (t/ha) to nitrogen fertiliser (excluding GS49 timing)

	Nitrogen Rate (mean of 4 nitrogen timing treatments)		
	No Nitrogen	50 kg/ha N	100 kg/ha N
Yield (t/ha)	1.89	1.75	1.53
Difference to control	0	-0.14	-0.36

Other than nitrogen rate there were few significant yield differences due to timing, however at 50kg/ha N the 50% split application significantly reduced yield in comparison to the same dose rates applied as single timings (Figure 1). At the 100 kg/ha N rate, the only nitrogen timing that did not reduce yield was the application at GS49 (1st awns emerging). From the protein results (Table 3) it would appear that the detrimental effect of 100kg/ha N was avoided at this later nitrogen application due to limited uptake.

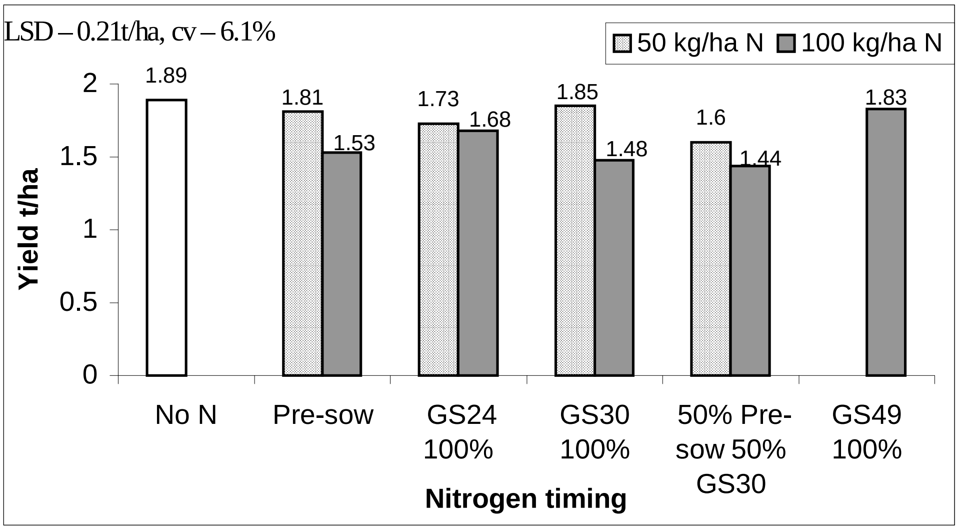

Figure 1. Yield response to individual nitrogen timings and rates (t/ha)

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 (excluding GS49 timing)

	Grain protein (mean of 4 nitrogen timing treatments)		
	No Nitrogen	**50 kg/ha N**	**100 kg/ha N**
% Protein	8.9	12.6	14.3
Difference to control	0	+3.75	+5.45

At 50 kg/ha N there was a significant increase in grain protein as a result of increased nitrogen. However this was not the case at 100kg/ha N, which though giving higher protein overall showed no significant difference due to timing with the exception of the very late application at GS49, which gave very low proteins, most likely as a result of restricted uptake.

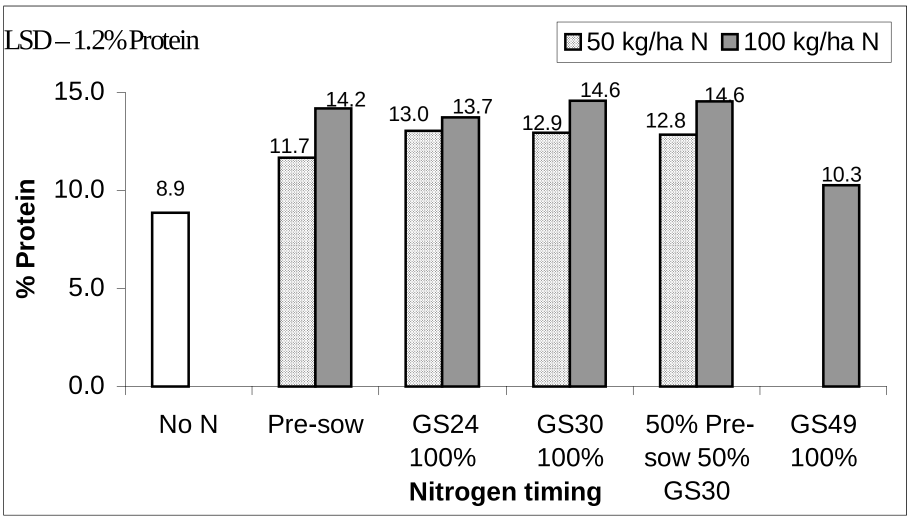

Figure 2. Protein response to individual nitrogen timings and rates

Screenings (over 2.2 mm screen) and retention (2.5mm screen)

Applying either 50kg or 100kg/ha nitrogen caused a significant increase in screenings compared to the control. At 50kg N/ha there were no differences in screenings as a result of nitrogen timing. Increasing the nitrogen rate to 100kg/ha not only caused a marked increase in overall screenings, but the treatments with any nitrogen applied at sowing had significantly higher screenings than those where all nitrogen was applied in crop. In terms of GS49 timing, the crop probably did not take up much of this nitrogen and therefore had little impact on screenings.

In terms of retention the pattern was the same with the best retention coming from the no nitrogen treatment followed by the lower nitrogen rate (Figure 4).

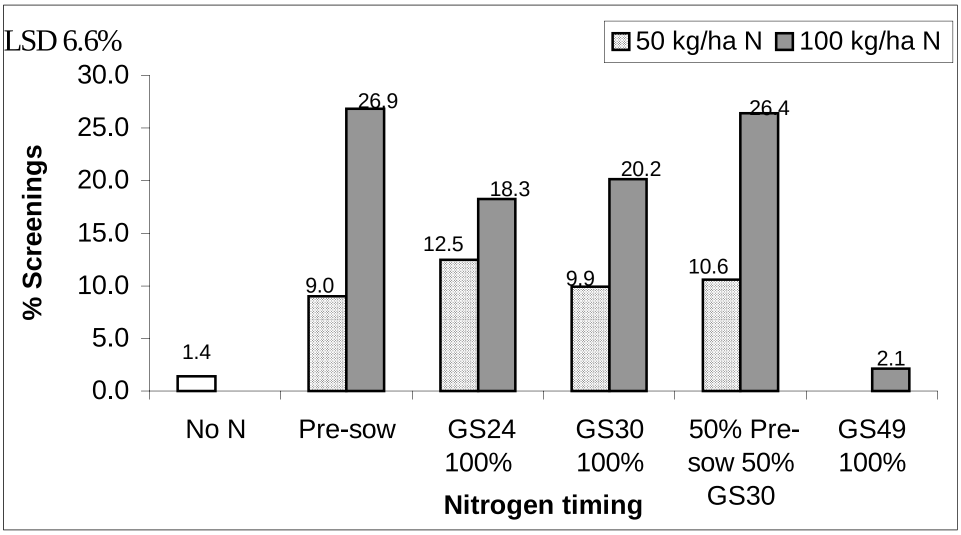

Figure 3. % Screenings (2.2mm) due to individual nitrogen timings and rates

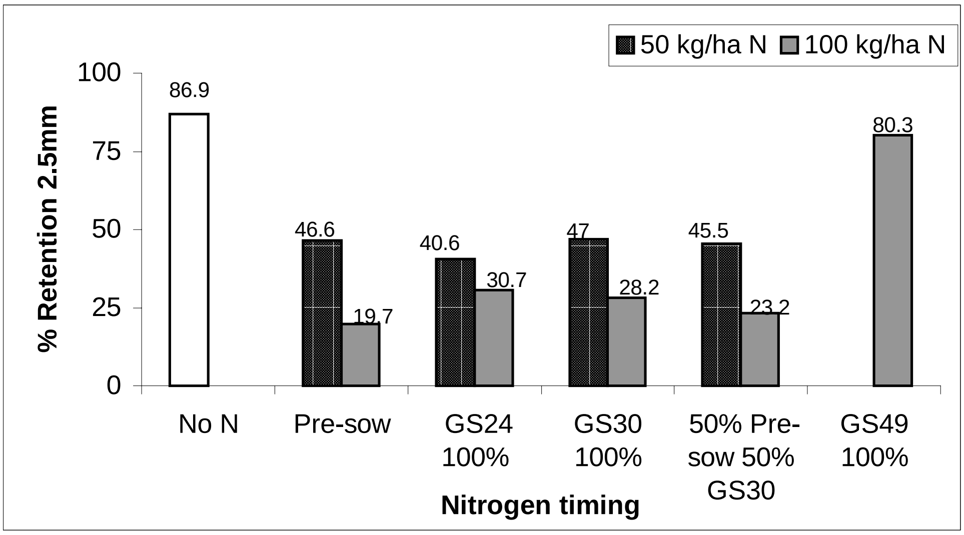

Figure 4. % Retention (2.5mm) due to individual nitrogen timings and rates

Crop Structure

The effect of nitrogen rate on screenings and retention can be clearly linked to crop structure (Table 4), since higher nitrogen rates and earlier nitrogen timings have created excess tillers which were lost during stem elongation leading to inferior grain size on those tillers that formed heads.

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 /m2**	**Ears/m2**	**Ears /plant**	**Tiller loss/m2**	**Yield t/ha**
0		398	304	2.87	94	1.89
50	100% Pre -sow	682	418	3.94	264	1.81
50	100% GS15/24	568	381	3.59	187	1.73
50	100% GS30	550	416	3.92	134	1.85
50	50% Pre-sow 50% GS30	620	420	3.96	200	1.60
100	100% Pre -sow	941	476	4.49	465	1.53
100	100% GS15/24	692	472	4.45	220	1.68
100	100% GS30	475	417	3.93	58	1.48
100	50% pre-sow 50% GS30	760	420	3.96	340	1.44
LSD (5%)		142	119			0.21

Interpretation

All nitrogen treatments in this trial led to inferior yield and grain quality characteristics. Whilst yields were not significantly reduced in every individual case the negative influence on screenings and retention was always significant compared to the control with no nitrogen. For example, whenever N was applied, 50kg/ha N increased screenings from 1-2% to approximately 10-12% and reduced retentions from approximately 85% to 40%. Whilst it could be argued that the protein content of the zero nitrogen plots was just below 9% at 8.9%, the applied nitrogen treatments were with one exception all over 12%.

In a season with such poor rainfall for October 7.5mm and frost affected heads, crop structures set up by nitrogen application could not be sustained, this was particularly noticeable at the higher nitrogen rate and earlier nitrogen timings which created excess tillering and tiller loss.

None of the treatments made the malt grade and were either classified as F1, F2 or F3 depending on protein level, screenings or retention. The treatment with the highest return (yield by price for a particular grade after allowing for the cost of urea) was the zero N treatment ($259/ha). Treatments with nitrogen either yielded less or were downgraded due to too high protein, screenings, or low retention (Table 5).

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

N application	**Yield**	**Prot.**	**Screen**	**Retent**	**Bin grade**	**Gross**	**Gross - urea**
No N	1.89	8.9	1.4	86.9	F1	259	259
50kg N Pre sowing	1.81	11.7	9.0	46.6	F1	248	198
100 kg N Pre sowing	1.53	14.2	26.9	19.7	F3	145	45
50kg N GS15	1.73	13.0	12.5	40.6	F1	237	187
100kg N GS15	1.68	13.7	18.3	30.7	F2	197	97
50kg N GS30	1.85	12.9	9.9	47.0	F1	253	203
100kg N GS30	1.48	14.6	20.2	28.2	F2	173	73
25kg Pre sowing, 25kg GS30	1.60	12.8	10.6	45.5	F1	219	169
50kg Pre sowing, 50kg GS30	1.44	14.6	26.4	23.2	F3	137	37

Commercial Practice

At current low commodity price for barley, 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 early tillering phase (from sowing up to GS15) and the rest of the N should be top-dressed (or applied as a foliar application) at GS15 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.