Barley Canopy Management Trial-Wimmera

By the BCG, Brooke Thompson and Nick Poole, FAR, NZ

This project looking at canopy management in malting barley is based on a similar protocol to the experiment run in wheat though this trial has been carried out with funding from the BCG.

Summary

- Gairdner barley gave significant yield responses to applied nitrogen of 1t/ha at 50kg/ha N and 1.27t/ha at 100kg/ha N applied.
- All treatments except the zero N control and 50kg/ha N pre sowing created a malting sample (GA1 grade), these two treatments falling in the feed category due to protein levels below 9% (8.7%).
- There was no significant yield differences due to timing, although increasing nitrogen from 50kg/ha N to 100kg/ha N produced a significantly higher yield (1% significance).
- Later nitrogen timing again resulted in higher protein content particularly at the higher nitrogen rate, though screenings for all treatments were below 2%.
- The mean yield of barley in this trial was 0.3t/ha higher than the identical trial carried out in wheat.

Background

In work to date it has shown that both barley and wheat respond similarly in terms of nitrogen timing: both its effect on crop structure and grain protein content. However, results on yield have been inconclusive. Earlier nitrogen applications pre sowing or at sowing tend to produce thicker crop canopies with higher tiller numbers but lower grain protein.

Unlike wheat, where high protein can be an advantage, malting barley requires grain protein within a specified range (9-12%) in order to secure a malting premium. Therefore delayed nitrogen application (until stem elongation) runs the risk of protein exceeding the maximum protein content (12%), particularly if the overall rate of nitrogen is too high.

In last seasons work (2004), carried out under the GRDC project SFS 00006, frosting and high temperatures in October prevented any response to applied nitrogen. This years work (2005) runs the same treatment list as 2004.

Methods

Plot size: 25m x 6m

Replicates: 4

Gairdner barley was dry sown on Wimmera clay at Lubeck on 1st May at a plant population of 128 plants/m^2 with variable establishment. The effective sowing date was 9th June when the autumn break occurred, 34.8mm falling at Longerenong over three days (nearest BOM station). 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 - identical to that in wheat.

Table 1: Nitrogen (urea) timing and rate (kg/ha N) applied to Gairdner barley

Treatment Timing	Rain(mm) following	Growth Stage Description
Untreated		No nitrogen applied
100% N pre-sowing (25th April)	11.8 – (9/6)	All nitrogen applied pre-sowing
100% N GS15,23 (9th August)	4.8 – (10/8)	All nitrogen applied at mid tillering
100% N GS31 (29th August)	5.2 – (30/8)	All nitrogen applied at first node
100% N GS37 (23rd September)	1.4 – (23/9)	All nitrogen applied at flag leaf tip visible
50% N pre sowing plus 50% N GS31	As above	50% of N applied pre-sowing and 50% at first node
25% N pre sowing plus 75% N GS37	As above	25% of N applied pre-sowing and 75% at flag leaf emergence

Available Soil Nitrogen status, March 21st – 48kg/ha N (0-60cm)

Each nitrogen timing was applied at two different nitrogen rates: 50 and 100kg/ha N, with the exception of the GS37 treatment timing, which nitrogen was only applied at 100kg/ha N.

Growing season rainfall (April to October) recorded at Longerenong was 242.2mm with a further 50.4mm recorded in November, most of which fell on November 8th.

Results

Yield

Nitrogen rate

There was a significant yield response (0.99t/ha) to 50kg/ha N with a further 0.27t/ha when a further 50kg/ha N was added (Table 2 and Figure 1).

Table 2: Yield response (t/ha) to nitrogen fertiliser at two rates – mean of four nitrogen timing treatments (excluding GS37 timing)

	No nitrogen	50 kg/ha N	100 kg/ha N
Yield (t/ha)	3.02	4.01	4.29
Difference to control	0	0.99	1.27

Nitrogen timing

Though there was a trend for mid-tillering (GS15,23) applications of nitrogen to be higher yielding, this difference could not be shown to be statistically significant in this trial.

There was also a trend for nitrogen split over two timings: seedbed and first node (GS31) to be higher yielding than the individual doses applied at either seedbed or GS31. This result was in contrast to that observed in wheat where GS31 nitrogen was superior to the split at 50kg/ha N level.

The GS37 top dressing application illustrated that, while it was not the optimum timing for increasing yield, a 0.8t/ha improvement could still be achieved.

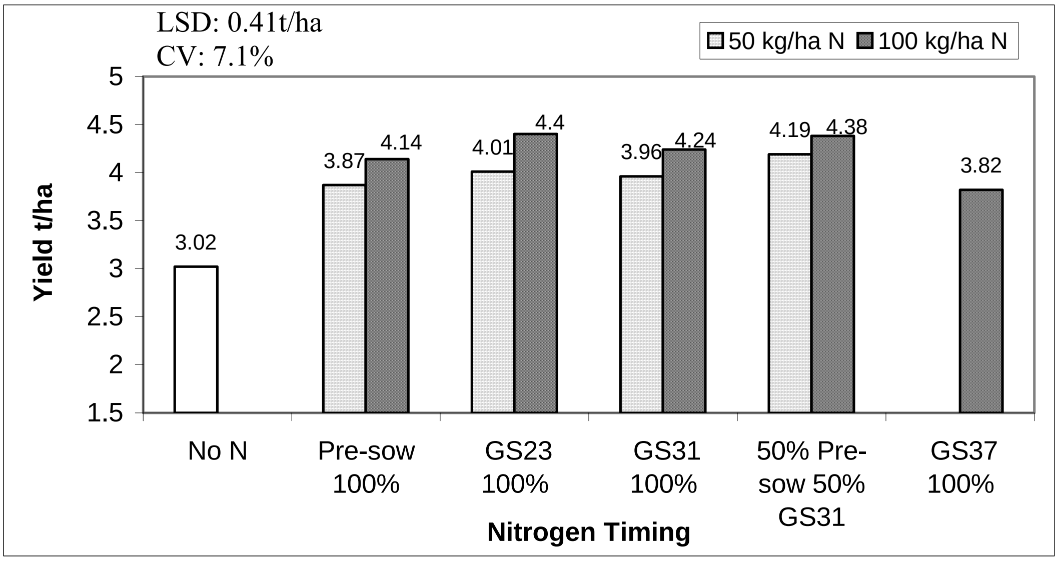

Figure 1: Yield response to individual nitrogen timings and rates (t/ha)

Protein

Nitrogen rate

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

50kg/ha N produced a modest increase in protein due to the dilution effect caused by a 1t/ha yield increase.

At 100kg/ha N the yield increase over 50kg/ha N was small and the increase in grain protein more substantial.

Table 3: Protein response (%) to nitrogen fertiliser at two rates – mean of four different nitrogen treatments (excluding GS37 timing).

	No nitrogen	50 kg/ha N	100 kg/ha N
Protein %	8.7	9.15	10.8
Difference to control	0	+0.45	+2.1

Nitrogen timing

There was a significant trend for later applications of nitrogen to produce higher protein levels as was found to be the case with wheat.

At 50kg/ha N the pre sowing seedbed application did not make the required 9% malting grade while all in-crop applications were over 9% (Figure 2).

At 100kg/ha N the influence of later nitrogen topdressing on protein was more extreme with applications applied at stem elongation generating proteins nearer the 12% cut off for malting.

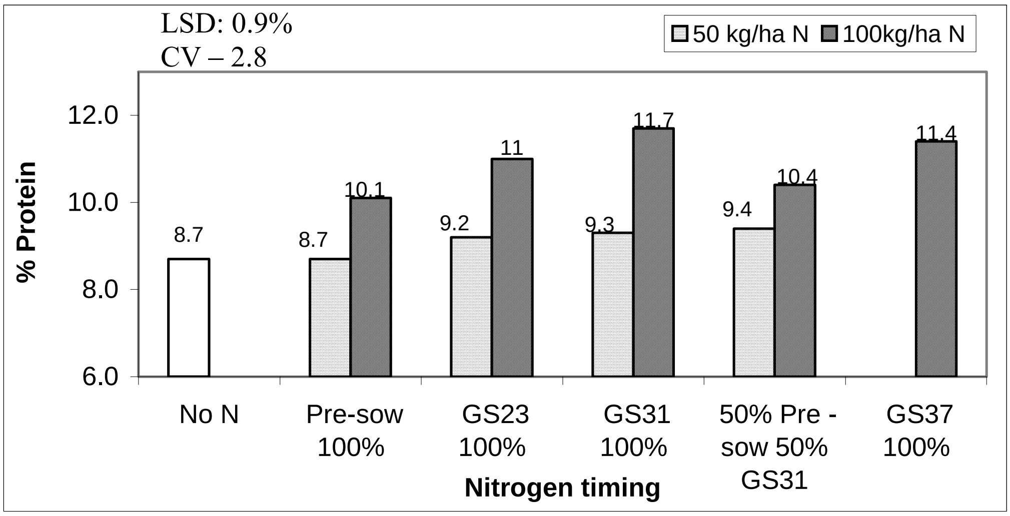

Figure 2: Protein response to individual nitrogen timings and rates

Screenings

There were few significant differences in screenings due to nitrogen timing since all screenings irrespective of treatment were under 2%.

There were little differences in retention. Retention values for all values were above 92%.

Crop Structure

Tiller counts and ear counts were carried out on four selected treatments only. These counts illustrated that there was a significant increase in tiller number associated with increasing nitrogen rate. The retention of tillers to ears at harvest was approximately 60-70% with higher nitrogen rates producing lower retention (Table 4).

Interpretation

In a trial with a clear response to nitrogen there was less indication of a yield benefit from nitrogen delayed until early stem elongation as was the case in the equivalent wheat experiment.

As with wheat there was a trend for later timed nitrogen to produce higher grain protein. At the low nitrogen level (50kg/ha N applied) this was an advantage since pre sowing nitrogen did not exceed the grain protein level of the untreated which fell short of 9% minimum for malting. However at 100kg/ha N the potential disadvantage of later timing was also apparent since the grain protein content of GS31 nitrogen was 1.6% higher than seedbed applied nitrogen, though this was still within the receival standards for malting barley.

Table 4: Influence of nitrogen rate and timing on crop structure and yield (tillers/m^2, ears/m^2, ears per plant (based on 128 plants/m2), % tiller retention and t/ha)

Rate kg/ha N	Timing	Tillers/ m^2	Ears/ m^2	Ears/ plant	% Tiller retention	Malt quality	Yield t/ha
0		468	340	2.66	73	feed	3.02
50	100% Presow	690	477	3.73	69	feed	3.87
50	100% GS15/23	----	----	----	----	GA1	4.01
50	100% GS31	----	----	----	----	GA1	3.96
50	50% Pre-sow 50% GS31	----	----	----	----	GA1	4.19
100	100% Pre -sow	920	552	4.31	60	GA1	4.14
100	100% GS15/23	----	----	----	----	GA1	4.4
100	100% GS31	----	----	----	----	GA1	4.24
100	50% pre-sow 50% GS31	----	----	----	----	GA1	4.38
100	100% GS37	----	----	----	----	GA1	3.82
100	25% pre-sow 75% GS37	650	473	3.70	73		4.16

Commercial Practice

With the inherent danger of exceeding the required protein content for malting barley with stem elongation nitrogen, malting barley looks better suited to a split application of nitrogen based on relatively small doses at sowing (20-30kg/ha N with early stem elongation follow ups timed at GS30-31 (first node)). From this work if a single dose was to be adopted, the mid-tillering application (GS23,15) looked to be the most effective.

The work illustrated that even flag leaf emergence (GS37-39) nitrogen applications produced considerable yield increases over and above the untreated, illustrating the potential to adjust your approach to nitrogen management as late as the third week in September with regard to a follow up in-crop N dose. Whilst this approach holds considerable risk in terms of increased protein content it may still represent an opportunity of adjusting nitrogen strategy later in the season to take account of an improving seasonal outlook.