Barley Canopy Management Trial - Mallee

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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 Mallee environment.

Summary

- With the crop under severe water stress for much of the growing season the yields were very low - 1 t/ha or less.
- Under these conditions there was no response to applied nitrogen, with a trend for applied N to reduce yield. The influence of applied nitrogen was observed in the grain protein content, however yields were so low that even the zero N plots gave a protein level of 15%.
- No single nitrogen timing was more detrimental than another compared to the untreated in terms of yield, however at higher plant populations screenings were significantly increased by seedbed nitrogen in comparison to GS30 nitrogen.
- Plant populations of 270 plants/m2 were significantly lowering yielding than plant populations of 100 and 200 plants/m2, with significantly more screenings

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 autumn sown wheat crops, 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 specified range. As already seen in the wheat canopy trial 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 underfeed. 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 GS30-31 N.

Methods

Gairdner was sown on 4th June at 3 different plant populations 103 plants/m^2 (target 100 plants/m^2), 197 plants/m^2 (target 200 plants/m^2) and 272 plants/m^2 (target 300 plants/m^2). The crop was then treated with standard inputs with the exception of nitrogen fertiliser, which was applied at 40 kg/ha N in accordance with the treatment list in Table1.

Table 1. Nitrogen (urea), timing and rate (kg/ha N) applied to Gairdner – Birchip, Mallee

Treatment Timing	Growth Stage Description
Untreated	No nitrogen applied
100% N pre-sowing – 4th May	All nitrogen applied pre sowing of the crop
100% N GS15/23 – 5th August	All nitrogen applied at 5-6 leaf stage (mid. tillering)
100% N GS30-31 – 25th August	All nitrogen applied at start of stem elongation
50% N pre sowing; 50% N GS15/23 – 4th May; 5th August	50% of N applied at pre-sowing and 50% at mid tillering
50% N GS15/23; 50% N GS30-31– 5th August; 25th August	50% of the N mid tillering and 50% N applied at start of stem elongation

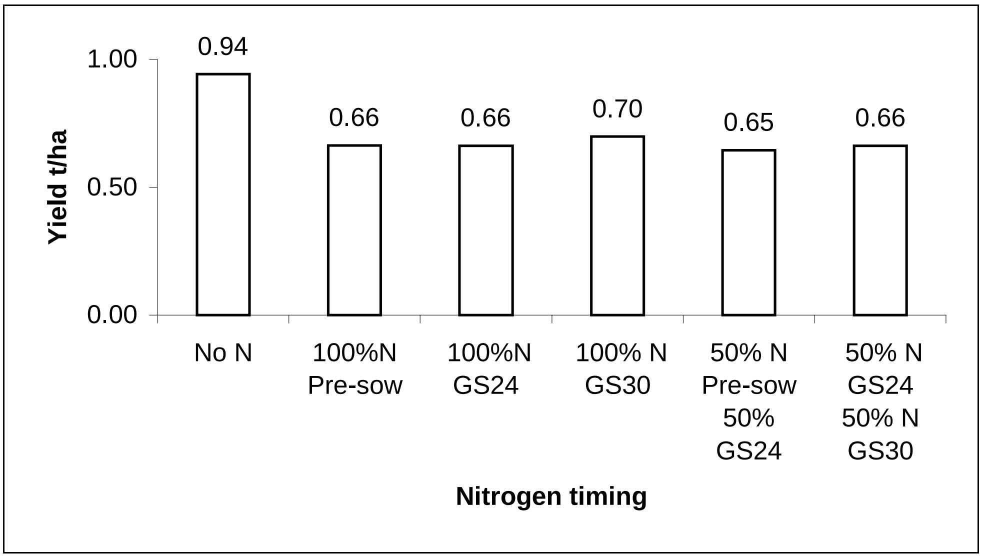
Adequate soil moisture was a constraint in this trial in late May and then almost continually from mid August onwards.

The trial was assessed for tiller numbers, disease, yield and quality. Soil tests revealed a soil N reserve of 64 kg/ha N over a 0-60 cm at sowing on this Mallee clay-loam site.

Results

Yield

At Birchip there was no yield response (Figure 1) to nitrogen fertiliser at any of the three plant populations, however there were significant effects on protein, albeit that all grain was over 15% protein (Figure 2).



LSD – 0.13t/ha, c.v. – 15.5%

Figure 1. Influence of nitrogen fertiliser (kg/ha N in the form of urea) on barley yield (t/ha) – mean of 3 plant populations

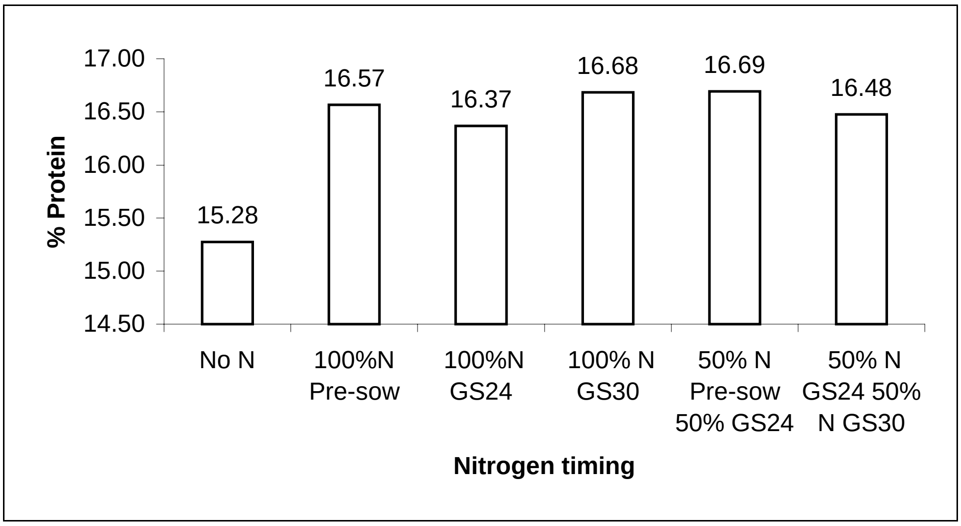
In terms of plant population the thickest plant population 272 plants/m2, produced significantly lower yields than the 100 or 200 plants/m2, between which there was no significant yield difference (Table 2).

Table 2. Influence of plant population on yield t/ha – mean of 6 different nitrogen treatments.

Plant Population/m2	Yield t/ha	% Screenings	% Protein
103	0.75	47.8	16.3
198	0.76	47.5	16.3
272	0.63	57.8	16.4
LSD (5%) t/ha	**0.07**	**4.8**	**0.3**

Protein

Protein levels were significantly increased by the addition of nitrogen, but there were few significant effects due to nitrogen timing (Figure 2).



LSD – 0.27% Protein

Figure 2. Protein response to individual nitrogen timings and rates (% Protein) – mean of 3 plant populations

Table 3. Influence of plant population combined with nitrogen timing and rate on yield (t/ha), % screenings & % Protein

N Timing	N Rate	Plant/m2	Yield t/ha	Screening %	% Protein
No nitrogen	0	103	0.95	44.6	15.5
	0	198	1.01	38.0	15.2
	0	272	0.87	52.9	15.1
100% N pre-sow	40	103	0.73	53.7	16.7
	40	198	0.70	46.1	16.2
	40	272	0.56	65.8	16.8
100% N GS23	40	103	0.66	46.6	16.4
	40	198	0.68	53.2	16.4
	40	272	0.64	63.7	16.4
100% N GS30	40	103	0.73	44.8	16.7
	40	198	0.75	44.7	16.7
	40	272	0.61	53.7	16.7
50% N pre-sow fb. 50% N GS23	40	103	0.73	50.0	16.5
	40	198	0.68	51.5	16.7
	40	272	0.53	56.5	16.9

50% N GS23	40	103	0.68	46.9	16.4
fb. 50% N GS30	40	198	0.75	51.7	16.5
	40	272	0.56	54.2	16.6
LSD			0.18	11.7	0.7

The highest plant populations produced the lowest yields and the highest screening levels. For any given plant population the zero nitrogen plots produced the highest yields and lowest screenings. The highest level of screenings was associated with the highest plant populations fertilised with early nitrogen. These results can be linked to the crop structure assessments that illustrate that higher tiller number associated with higher plant populations lead to excess tillers that the crop was unable to fill.

Table 4. Influence of plant population on crop structure – mean of 6 different nitrogen treatments.

Plant Population/m2	Tillers/m2	Yield t/ha
103	586	0.75
198	674	0.76
272	693	0.63
LSD (5%)	45	0.07

Increasing plant population from 100 plants/m2 to 200 plants/m2 significantly increased tiller number/m2 but did not affect final yield.

Interpretation

There was no value to adding nitrogen fertiliser in this trial, since there was no yield increase from its application and the lift in protein was not associated with any premium benefit (protein of zero N plots already being in the 15.1-15.5% range). Increasing the plant population from 100 plants/m2 to 200 plants/m2 only served to increase costs since yields were the same from both plant populations. Increasing plant population to 270 plants/m2 reduced yield and significantly increased screenings.

Commercial Practice

In seasons with no moisture in the profile at seeding it is a high risk strategy to pre-drill nitrogen. The best strategy for such a start to the season is to sow the crop with the minimum amount of N (as applied with the DAP or MAP) and then topdress the crop during the season depending on seasonal conditions and forecasts.

Applying nitrogen fertiliser late in the season to malt barley may increase protein levels to unacceptable levels – in the Mallee it is advisable to apply N to Gairdner barley, f required, before the mid tillering phase.