Wheat 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

- At yield levels just under 1t/ha there was no yield response to applied nitrogen in this trial at either plant population
- With several individual nitrogen treatments, lower plant populations of 120 plants/m^2 significantly out yielded the same N treatment applied at populations of just over 200 plants/m^2
- Protein content of grain derived from lower plant populations was significantly higher than that from higher plant populations, despite being in most cases associated with higher yields
- The significant increases in grain protein associated with nitrogen application did not influence grain price as protein level of the zero N treatments were already in excess of 15%

Background

Of those factors, which are under the grower's control, it is nitrogen management and plant population that 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.

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

Many other BCG trials reported in this booklet are linked 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 climatic conditions when applied as a top dressing, 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

Yitpi wheat was sown at Birchip on 17th of May at two different plant populations 120 plants/m^2 (target 100 plants/m^2) and 212 plants/m^2 (target 200 plants/m^2). The crop was then 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 Yitpi Wheat – Birchip

Treatment Timing	Growth Stage Description
Untreated	No nitrogen applied
100% N pre-sowing –17th 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 GS30 – 17th May; 25th August	50% of N applied at pre- sowing and 50% at start of stem elongation

All nitrogen applications were applied at 2 different rates of 30 and 60 kg/ha N. 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, head counts, canopy size, disease and 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 either nitrogen rate applied.

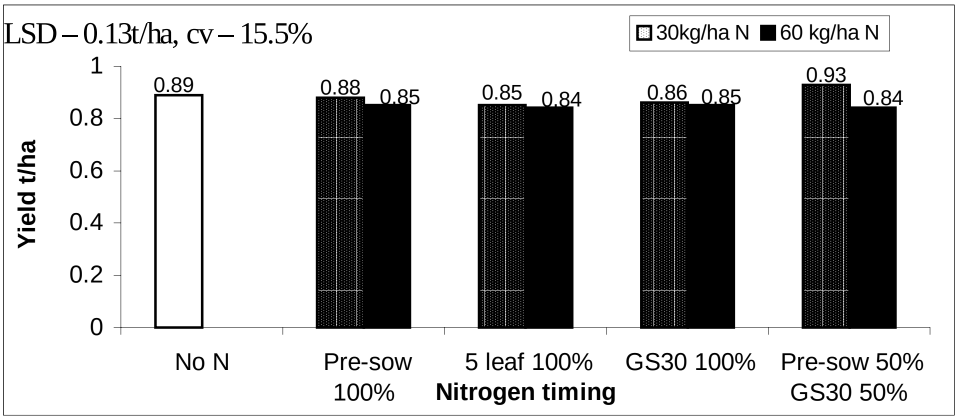

Figure 1. Influence of nitrogen fertiliser (kg/ha N in the form of Urea) on yield t/ha – mean of two plant populations.

In terms of plant population there was again no significant difference in yield between the two different populations tested (Table 2).

Table 2. Influence of plant population on yield t/ha, screenings and protein – mean of 5 different nitrogen treatments.

Plant Population/m2	Yield t/ha	% Screenings	% Protein
120	0.94	2.3	17.1
212	0.79	3.2	16.4
LSD (5%)	**0.18**	**1.1**	**0.6**
Significance	**ns**	**ns**	**P<0.05**

Protein

Protein levels were significantly increased by the addition of nitrogen, with the highest nitrogen rates giving the highest protein levels. There was no effect of nitrogen timing (Figure 2).

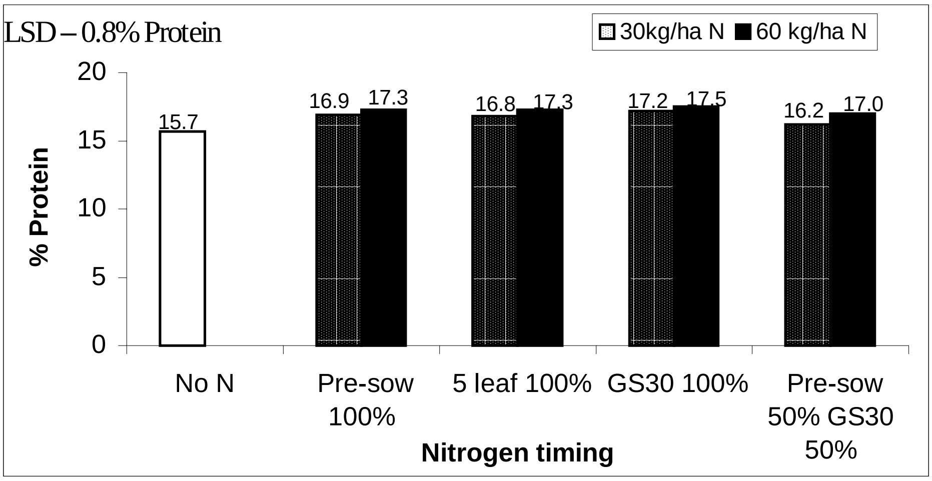

Figure 2. Protein response to individual nitrogen timings and rates (30 and 60kg/ha N in the form of Urea) – mean of 2 plant populations

There was a significant yield interaction between plant population and nitrogen timing, which suggested that as nitrogen timing was delayed so the yield from higher plant population declined, whilst the yield output from the lower plant population remained the same (Table 3). The same trend was apparent at both high and low nitrogen rates.

Crop structure assessments revealed that whilst tiller counts and ear counts were higher with 200 plants/m^2, loss of tillers during stem elongation was much greater with 200 plants/m^2 than it was with 120 plants/m^2 (Table 4).

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

Plant/m2	N Timing	N Rate	Yield t/ha	Screenings%	Protein %
120	No nitrogen	0	0.96	2.3	16.1
212	No nitrogen	0	0.82	3.0	15.3
120	100% N pre-sow	30	0.87	2.5	16.9
212	100% N pre-sow	30	0.89	2.8	16.8
120	100% N 5 leaf	30	0.95	2.0	17.5
212	100% N 5 leaf	30	0.75	3.9	16.1
120	100% N GS30	30	1.01	2.1	17.8
212	100% N GS30	30	0.72	3.2	16.6
120	50% N pre-sow +50% N GS30	30	0.93	2.5	16.7
212	50% N pre-sow +50% N GS30	30	0.93	2.8	15.8
120	100% N pre-sow	60	0.94	2.3	17.7
212	100% N pre-sow	60	0.75	3.5	16.9
120	100% N 5 leaf	60	0.97	2.1	17.2
212	100% N 5 leaf	60	0.71	2.9	17.3
120	100% N GS30	60	0.98	2.4	17.8
212	100% N GS30	60	0.72	3.7	17.1

120	50% N pre-sow +50% N 60 GS30	0.85	2.6	16.9
212	50% N pre-sow +50% N 60 GS30	0.83	2.9	17.1
[Within Seed rates, zero N v Treatment]		**0.17**	**1.5**	**1.0**
[Within Seed rates, Trt v Trt]		**0.19**	**1.7**	**1.1**
[Other Comparisons, zero N v Treatment]		**0.20**	**1.6**	**1.0**
[Other Comparisons, Trt v Trt]		**0.22**	**1.8**	**1.1**

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

Nitrogen Treatment		**Crop Structure Assessment**							
Rate kg/ha N	**Timing**	**Tillers/m2**		**Ears/m2**		**Ears/plant**		**Tiller loss/m2**	
	Plant population/m^2	120	212	120	212	120	212	120	212
0	No nitrogen	303	485	194	252	1.62	1.19	109	233
30	100% N pre-sow	330	429	187	254	1.56	1.20	143	175
30	100% N 5 leaf	256	378	176	229	1.47	1.08	80	149
30	100% N GS30	284	415	179	210	1.49	0.99	105	205
30	50% N pre-sow + 50% N GS30	255	364	165	223	1.38	1.05	90	141
60	100% N pre-sow	301	427	208	241	1.73	2.01	93	198
60	100% N 5 leaf	258	432	166	234	1.38	1.10	92	198
60	100% N GS30	310	433	208	233	1.73	1.10	102	200
60	50% N pre-sow + 50% N GS30	276	389	169	245	1.41	1.16	107	144

Interpretation

There was no value 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 15.3-16.1% range). Increasing the plant population from 120 plants/m^2 to 212 plants/m^2 only served to increase cost – there was no yield benefit at the higher seeding rate.

Whilst there was no benefit to applied nitrogen there was a significant yield interaction between plant population and nitrogen timing, which suggested that as nitrogen timing was delayed so the yield from the higher plant population declined. In contrast the yield output from the lower plant population remained the same as nitrogen application timing moved later. The same trend was apparent at both high and low nitrogen rates.

Commercial Practice

In seasons, with no moisture in the profile 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 (applied with the DAP or MAP) and then top-dress the crop during the season depending on seasonal conditions and forecasts. In the Mallee it is advisable to apply N before or at the end of tillering.

Applying nitrogen fertiliser later in the season to wheat will increase protein levels – depending on the increments paid for protein this may be financially worthwhile.