Wheat Canopy Management Trial – Mallee

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This trial is a part of a nationwide GRDC funded project (SFS 00015) which started in July 2005. The project looks at canopy management and its interaction with disease management in the different climates of southern Australia. This trial had the objective of examining how the crop canopy was influenced by nitrogen rate and timing in the Mallee environment.

Summary

- On a site with high soil N at sowing, yields of 2.0 - 2.5 t/ha were achieved and there was no yield benefit from nitrogen applications of 30 and 60kg/ha N, thus all applied nitrogen treatments lost money relative to the zero nitrogen plots.
- Since all protein levels were above 14% there was no increased grain premium as a result of nitrogen application, even though there was 0.6% lift in protein due to nitrogen application.
- At GS31 APSIM had calculated that there was only a 10% probability of the yield exceeding the zero N treatment by 0.2 t/ha (the amount necessary just to cover costs) based on climate criteria to that date and predictions for the rest of the season based on the last 100 years data.
- For the second year in succession and despite a later planting date, lower plant populations (126 plants/m^2 in 2005 and 120 plants/m^2 in 2004) produced significantly higher yields than higher populations (180 - 210 plants/m^2).
- Whilst there was no yield advantage associated with delaying the main nitrogen application until early stem elongation (GS30-31), the delay gave greater opportunity to assess the seasonal outlook and make better use of predictive yield models such as APSIM.

Background

This trial followed a similar format to 2004 in terms of treatments; however the sowing date was considerably later (25th June) than the two previous years, due to the late break. Later sowings have the effect of compressing the growing season such that the crop spends less time in each development phase.

The trial therefore sheds light on whether delaying nitrogen application until early stem elongation (GS30-32) would be detrimental with the late sowing. Delaying the majority of nitrogen until early stem elongation has been successful in both previous seasons; in 2004 it enabled growers to make more informed decisions on whether it was worth applying any nitrogen fertiliser (trials subsequently showing that no nitrogen was required) and in 2003 crops top dressed at GS30-31 significantly out yielded crops with N applied at sowing. In previous seasons though crops grown with later nitrogen application have produced fewer tillers, they have compensated with larger grain size and more grains per head. In this trial there was a question mark over whether later sown crops would perform the same since they had less time to compensate.

Methods

Plot size: 25m x 3m

Replicates: 4

Yitpi wheat was sown on 25th June at two different plant populations 126 plants/m^2 (target 100 plants/m^2) and 181 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, Mallee

Available soil nitrogen status, March – 82.5 kg/ha N (0-70cm with 22.6 kg/ha N in top 10cm)

Treatment Timing	Growth Stage Description
Untreated	No nitrogen applied
100% N pre-sowing 25th June	All nitrogen applied pre sowing
100% N GS24 2nd September	All nitrogen applied at main stem plus 4 tiller stage (mid - late tillering)
100% N GS31 20th September	All nitrogen applied at start of stem elongation (first node)
50% N pre sowing 25th June plus 50% N GS31 20th September	50% of N applied at pre-sowing and 50% at start of stem elongation

All nitrogen applications were applied at two different rates 30 and 60 kg/ha N.

Growing season rainfall (April to October) recorded at Birchip was 197mm with 47mm falling in October, with a mean temperature of 22.4 °C for the same month.

Herbicide: Triflur X 0.8l/ha – 2nd May

Atlantis 300ml/ha + Hasten at 1% - 4th August

MCPA500 350 ml/ha + Lontrel 100ml/ha – 5th September

Results

There was no yield response to the application of nitrogen fertiliser in this trial, whether applied at 30 or 60 kg/ha N. Though not statistically significant there was a trend for nitrogen application to reduce yield as it did in the lower yielding trial performed in 2004.

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

	No nitrogen	30 kg/ha N	60 kg/ha N
Yield (t/ha)	2.22	2.14	2.13
Difference to control	0	-0.08	-0.09

Since the zero nitrogen blocks were the highest yielding treatments there was little significance in the effects of nitrogen timing, however nitrogen at sowing produced inferior yields to the untreated whilst later nitrogen timings at early stem elongation (GS31) had less negative impact on yield (differences not statistically significant –Figure 1). In part, this could have been due to reduced uptake of the later timed N rather than a less detrimental effect of nitrogen at this timing; however the influence of later nitrogen doses were still observed to have significant effects on protein levels at the higher nitrogen rates (Figure 3).

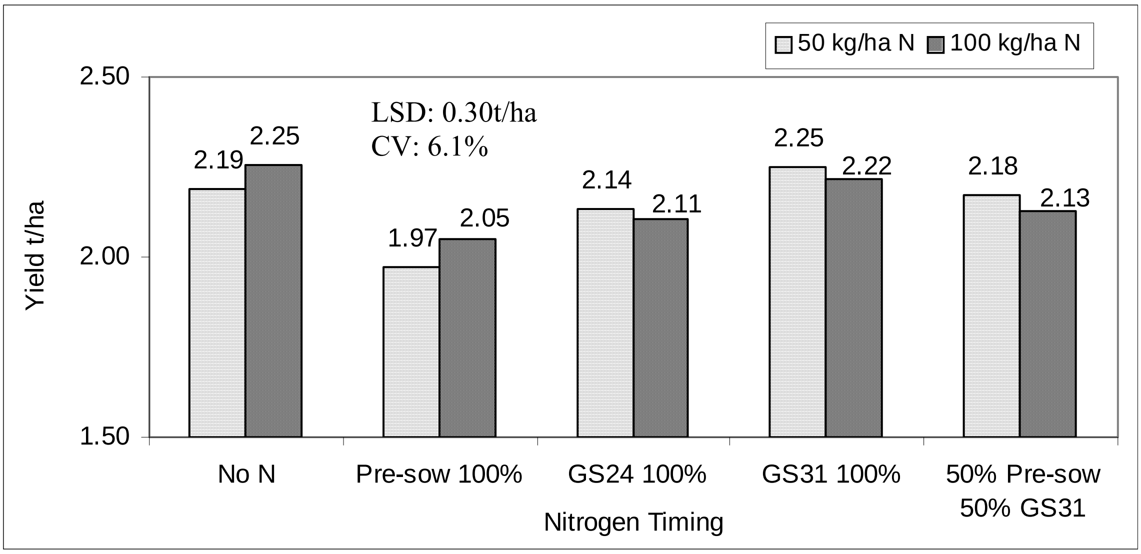

Figure 1: Yield response (t/ha) to individual nitrogen timings and rates – mean of 2 plant populations.

For the second year in succession lower plant populations (this season 126 plants/m^2, last season 120 plants/m^2) were significantly higher yielding than the higher plant populations (186 plants/m^2), despite the later sowing date. The mean yield of all treatments at the low population (126 plants/m^2) was 2.26 t/ha compared to 2.04 t/ha at the higher population (181 plants/m^2, 210 plants/m^2 last season). There were no significant interactions between nitrogen management and plant population at the different nitrogen rates and timing (Figure 2).

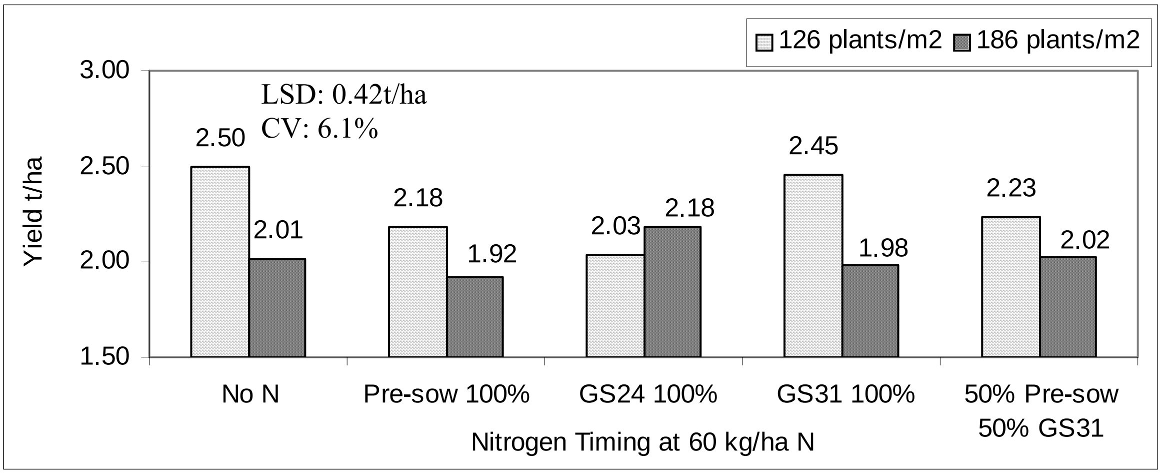

Figure 2: Influence of plant population on yield (t/ha) with no nitrogen and 60 kg/ha N applied.

Protein

The low yields meant that protein levels were in excess of 14.5% in the zero nitrogen plots. The application of nitrogen had small positive effects on protein but these did not influence premiums as levels were already very high in the un-fertilised treatments. There was no significant impact of the higher nitrogen level on protein (Table 3).

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

	No nitrogen	30 kg/ha N	60 kg/ha N
Protein %	14.9	15.5	15.5
Difference to control	0	+0.6	+0.6

LSD – 0.5%

Unusually the low plant populations produced significantly lower protein levels than the higher populations, normally lower plant populations produce higher protein levels (as was the case in the 2004 results), however this season the yield advantage of the low plant population was such that it diluted the protein content (Figure 3).

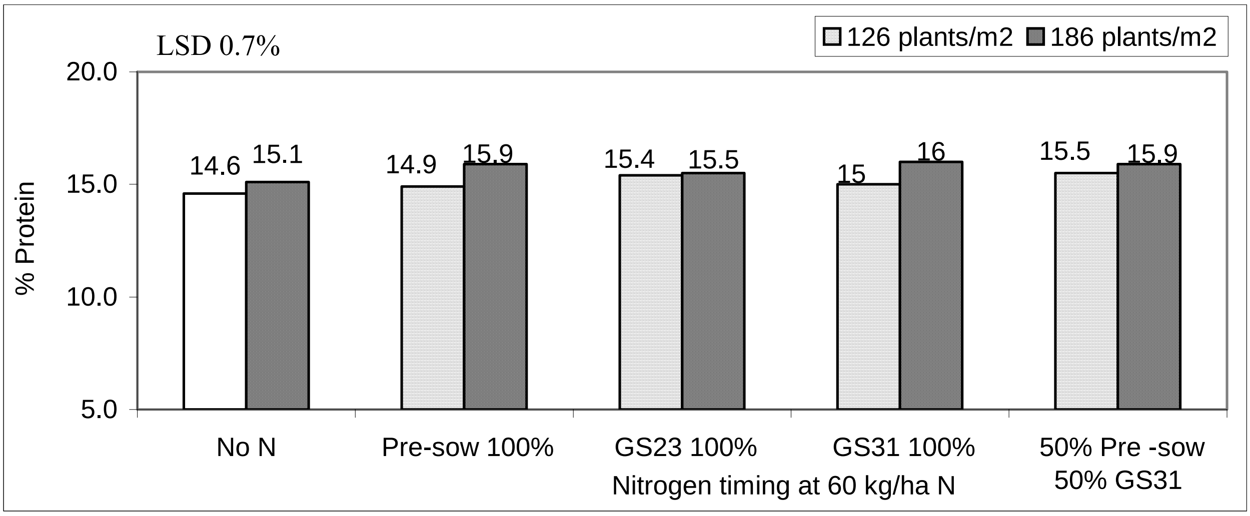

Figure 3: Influence of plant population and nitrogen application on % Protein.

Screenings

There were small differences in screenings between treatments, the most significant of which was that the low plant population had lower screenings (2.5%) than the higher population (2.9%). There was also a small but significant benefit in terms of test weight, with the lower plant populations giving 79.3 kg/hl as compared to 78.8 kg/hl.

Table 4: Influence of plant population combined with nitrogen timing and rate on yield and quality

N rate kg/ha N	Timing	Plants/m2	Yield t/ha	Protein %	Screenings %	Test Weight kg/hl
0		126	2.42	14.6	2.3	79.5
0		181	2.02	15.1	3.0	78.7
30	Seedbed	126	2.02	15.7	2.5	79.6
30		181	1.92	15.9	2.9	79.1
30	GS24	126	2.34	14.9	2.1	79.7
30		181	1.93	15.6	3.0	79.3
30	GS31	126	2.22	15.2	2.9	79.8
30		181	2.27	15.6	3.1	79.1
30	S'dbed+GS31	126	2.24	15.5	2.1	79.2
30		181	2.11	15.7	2.7	78.5
60	Seedbed	126	2.18	14.9	2.7	78.9
60		181	1.92	15.9	3.0	78.1
60	GS24	126	2.03	15.4	3.0	78.8
60		181	2.18	15.5	3.0	78.8
60	GS31	126	2.45	15.0	2.8	78.6
60		181	1.98	16.0	2.3	78.2
60	S'dbed+GS31	126	2.23	15.5	2.2	79.4
60		181	2.02	15.9	2.7	79.5
Significant difference			**P <.05**	**P< 0.05**	**P< 0.05**	**P< 0.05**
LSD			**0.42**	**0.7**	**1.1**	**1.3**

Crop Structure

The highest tiller numbers (recorded at the GS31) were associated with higher plant populations rather than earlier nitrogen timings or higher nitrogen rates, features which have tended to show up in previous experiments. The higher tiller numbers did not translate into higher ear numbers or higher yield (Figure 2.)

Table 5: Influence of plant population, nitrogen rate and timing on crop structure (tillers/m^2, ears/m^2, ears/plant and tiller loss/m^2)

Nitrogen Treatment		Crop Structure Assessment							
Rate kg/ha N	Timing	Tillers/m^2		Ears/m^2		Ears/plant		Tiller loss/m^2	
	Plant Population m^2	126	181	126	181	126	181	126	181
0	No nitrogen	426	537	326	340	2.6	1.9	100	197
30	100% N pre-sow	437	529	300	301	2.4	1.7	137	228
30	100% N GS24	401	486	----	----	----	----	----	----
30	100% N GS31	427	526	----	----	----	----	----	----
30	50% N pre-sow + 50% N GS31	405	524	299	340	2.7	1.9	106	184
60	100% N pre-sow	441	521	----	----	----	----	----	----
60	100% N GS24	433	534	----	----	----	----	----	----
60	100% N GS31	456	489	----	----	----	----	----	----
60	50% N pre-sow + 50% N GS31	457	497	----	----	----	----	----	----

Interpretation

With no response to nitrogen for the second season in succession at the Birchip site, it at first might appear that there is little value in the results gleaned from this trial, however the cost of nitrogen fertiliser meant that crops treated with nitrogen produced margins $46-160/ha lower than crops where no nitrogen fertiliser was applied (Table 5).

Therefore whilst overall yields were low, the difference in margin due to nitrogen management was considerable.

Table 6: Influence of nitrogen management and plant population on yield (t/ha) and margin ($/ha) after nitrogen and seed cost differences.

N rate kg/ha N	Timing	Plants/m^2	Yield (t/ha)	Margin after N cost ($/ha*)
0		126	2.42	442
0		181	2.02	364
30	Seedbed	126	2.02	337
30		181	1.92	313
30	GS24	126	2.34	396
30		181	1.93	315
30	GS31	126	2.22	374
30		181	2.27	377
30	S'dbed+GS31	126	2.24	377
30		181	2.11	348
60	Seedbed	126	2.18	335
60		181	1.92	282
60	GS24	126	2.03	307
60		181	2.18	330
60	GS31	126	2.45	384
60		181	1.98	293
60	S'dbed+GS31	126	2.23	344
60		181	2.02	301
Significant diff.			**P<0.05**	
LSD			**0.42**	

* application costs not included

Grain price ($182.5/t) based on AH grade of 14% protein at 3.0% screenings with $45/t deductions for freight charges. A seed cost difference of $5/ha has been allowed for the difference in plant population.

NOTE: Application costs have not been included in the calculations. Growers should apply their own costs to these. The following are guidelines only:

Pre sowing application costs - $30/ha
Top dressing - $5/ha
At sowing (Triple bin) - $ same as sowing

Commercial Practice

For the second season in succession and despite a later sowing date, optimum plant populations for Yitpi in this trial were less than 150 plants/m^2. Though there are only two plant populations in the trial, 120-130 plants/m^2 has given significantly higher yields (0.22t/ha 2005 and 0.15 t/ha 2004) than plant populations of 180-210 plants/m^2. Limited growing season rainfall (197mm in 2005) has meant that lower than normal plant populations have produced optimum results compared to previous work carried out by BCG (previous optimum 175 plants/m^2).

Formulating strategies that delay expenditure on inputs in order to take account of seasonal yield potential is the other key element to emerge from this work. Whilst the previous two years have not allowed us to fully evaluate the agronomic effects of early stem elongation nitrogen, it has enabled us to illustrate that delaying expenditure on nitrogen fertiliser can have significant advantages in terms of determining whether to apply the input at all. A decision made in late August/early September allows a much more reliable forecast of yield potential to be determined from simple decile based forecasts or more complex models such as APSIM.

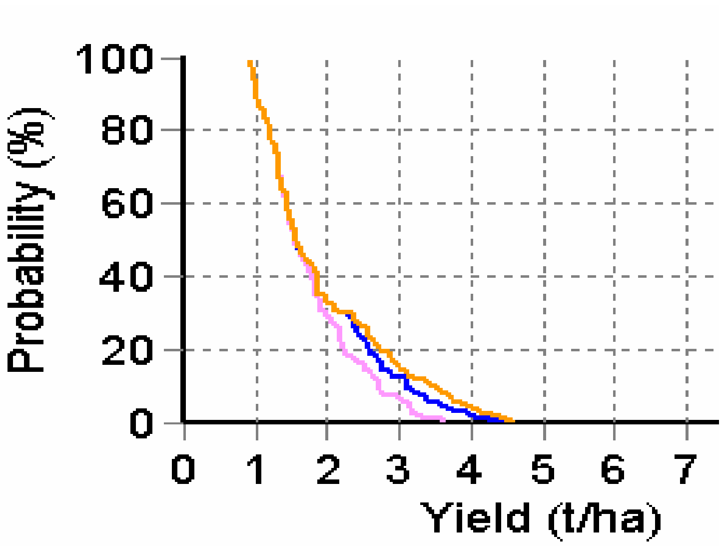

Figure 4. APSIM simulations of yield at 0, 30 & 60 kg/ha N at sowing June 25th and at GS31 (20th September).

Figure 4 depicts the yield probabilities surrounding nitrogen application at sowing (June 25th) and at GS31 (20th September). The graph illustrates that there was greater than a 50% chance that applying 30kg/ha and 60kg/ha N would not increase yield above the control (no N fertiliser). Furthermore the probability of achieving a 0.2 t/ha gain in yield from N fertiliser was less than 10%.