# Interaction of Nitrogen and Fertiliser Timing with Disease Management in Barley - Wimmera

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This trial is part of a new GRDC funded project (SFS 00015) which started in July 2005. The project looks at canopy management and its integration with disease management principles in the different climates of southern Australia.

## Summary

- In a high yielding trial (5-6 t/ha), Baudin barley gave small responses to fungicide (mean 2-4%), compared to Gairdner which gave no response.
- Nitrogen timing (100kg/ha N application split either between sowing and late tillering or between late tillering and early stem elongation) had a significant influence on crop structure, grain protein and response to fungicide but made no difference to yield.
- Where nitrogen was applied with the later split it reduced the need for fungicide in both varieties, due to crops being significantly thinner at the end of tillering.
- Whilst delaying nitrogen reduced the need for a fungicide and hence reduced the cost of production, it resulted in high protein grain that fell into a lower malt grade, thus savings in fungicide cost were outweighed by the influence of the nitrogen strategy on malting grade (protein content).
- In part this result was likely to have been influenced by the 100 kg/ha N rate which was at the high end of being optimal, with lower nitrogen rate it may have been possible to harness these savings without exceeding the maximum grain protein criteria.
- Though yield differences were small with both varieties there was evidence that a nitrogen strategy based on later timings reduced the requirement for a fungicide, with malting barley earlier nitrogen timing remains a key means of reducing grain protein, particularly if nitrogen rate is set too high for the yield potential.

## Background

The problem with using delayed nitrogen in a canopy management approach in malting barley is that it creates a higher risk of excessive protein in the grain, a factor likely to reduce malting premiums received by the grower. On the plus side, creating thinner crop canopies with later applied nitrogen can reduce disease pressure as well as giving growers a better opportunity to use their nitrogen inputs more strategically during the season.

As part of the new GRDC funded project, BCG along with project coordinator FAR (NZ) have been examining how different crop canopies influence the need for fungicide application. In this trial two malting varieties were sown to examine the possible interactions between N fertiliser and disease pressure in Baudin and Gairdner; Baudin is more susceptible to powdery mildew and leaf rust than Gairdner

## Methods

Plot size: 25m x 3m

Replicates: 4

Two varieties of barley: Baudin and Gairdner were dry sown on 7th June at a target plant population of 200 plants/$m^2$ (actual plant populations were Baudin 130 plants/$m^2$ & Gairdner 118 plants/$m^2$). The two varieties were subject to two variables: fungicide management and nitrogen management (Table 1 and 2). In all other respects the crops were treated with the same inputs.

Fungicide management: each variety was subjected to 4 fungicide strategies as outlined in Table 1.

**Table 1:** Fungicide management programs – Marnoo, Wimmera.

| Seeding 7th June | GS45 – 49 (Booting-1st awns) 4th October |
|---|---|
| 1. Untreated | |
| 2. Impact® in furrow 400ml/ha | |
| 3. Impact in furrow 400ml/ha | Opus® 250ml/ha |
| 4. No upfront treatment | Opus 250ml/ha |

Each fungicide strategy was grown under two nitrogen regimes applying 100kg/ha N applied at different timings (Table 2).

**Table 2:** Nitrogen regime (kg/ha N)

| Nitrogen Timing | | |
|---|---|---|
| **Sowing** | **GS25-30 (Aug 10)** | **GS33 (Sept 16)** |
| 1. 50kg/ha N | 50kg/ha N | ---- |
| 2. ---- | 50kg/ha N | 50kg/ha N |

## Results

Plant establishment and crop structure assessments

There was some evidence that fungicide treatment applied at sowing influenced barley establishment as Impact in furrow – flutriafol – gave slightly lower plant counts than those crops untreated with fungicide at sowing (Table 3).

**Table 3:** Effect of applying Impact (flutriafol) at sowing on establishment (plants/$m^2$) in Baudin and Gairdner – assessed 19th July GS12

| Fungicide treatment at sowing | Plants/$m^2$ | |
|---|---|---|
| | **Baudin** | **Gairdner** |
| Untreated | 137 | 120 |
| Impact 400ml/ha | 123 | 116 |

The two different nitrogen timing regimes created very large differences in crop structure, such that by late tillering (August 16th) there were significantly more tillers/$m^2$ and heads/$m^2$ in those crops treated with pre-sowing nitrogen (Tables 4 and 5).

**Table 4:** Effect of seedbed N on tillers/$m^2$ at GS31 in Baudin and Gairdner – 1st September

| Nitrogen regime | Tillers/$m^2$ | |
|---|---|---|
| | Baudin | Gairdner |
| 1. 50 N seedbed + 50 N GS25-30 | 614 | 521 |
| 2. 50 N GS25-30 + 50 N GS 33 | 467 | 413 |

**Table 5:** Effect of nitrogen strategy and fungicide treatment on heads/$m^2$ at the end of grain fills in Baudin and Gairdner – 23rd November

| Nitrogen regime | Fungicide trt. | Heads/$m^2$ | |
|---|---|---|---|
| | | Baudin | Gairdner |
| 1. Seedbed + GS25-30 | Untreated | 797 | 622 |
| | Impact f.b. Opus | 722 | 534 |
| 2. GS25-30 + GS33 | Untreated | 712 | 569 |
| | Impact f.b. Opus | 730 | 586 |

Yields

There were no significant differences in yield between the N and fungicide treatments for either Baudin (Figure 1) or Gairdner (Figure 2).

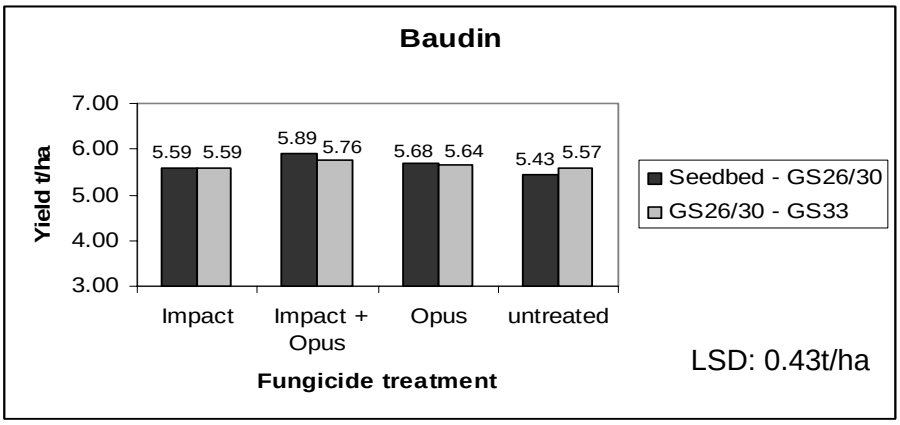


**Figure 1:** Effect of nitrogen strategy and fungicide treatment on yield t/ha

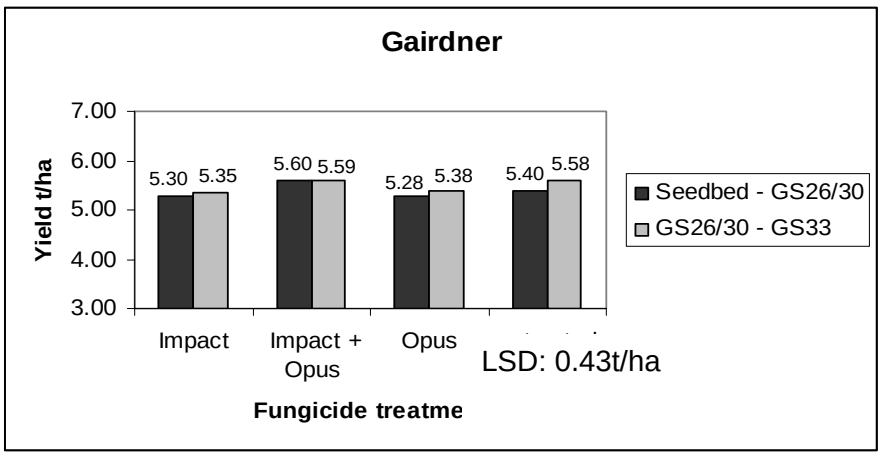


**Figure 2:** Effect of nitrogen strategy and fungicide treatment on yield t/ha

*Influence of variety*

Baudin was on average 0.21 t/ha higher yielding than Gairdner barley across all treatements.

*Influence of fungicide*

With earlier applied nitrogen there was a maximum fungicide response of 0.46 t/ha in Baudin, though when nitrogen was delayed, there was no significant response to fungicide, due to lower disease pressure.

Overall, Gairdner was less responsive to fungicide application. There was not a significant response to fungicide application, regardless of nitrogen timing.

The yield trends associated with individual fungicide applications were similar irrespective of nitrogen strategy (Table 6).

**Table 6:** % yield increase associated with individual fungicide applications

| Nitrogen regime | Fungicide treatment | % Yield (increase/decrease) | |
|---|---|---|---|
| | | Baudin | Gairdner |
| Seedbed + GS25-30 | Impact | 2.9 | -1.8 |
| | Impact f.b. Opus | 5.4 | 3.7 |
| | Opus | 4.6 | -2.2 |
| | **average** | **4.3** | **-0.1** |
| GS25-30 + GS33 | Impact | 0.36 | -4.1 |
| | Impact f.b. Opus | 3.4 | 0.2 |
| | Opus | 1.26 | -3.6 |
| | **average** | **1.7** | **-2.5** |

*Influence of nitrogen*

Irrespective of variety the yield trends were similar but in most cases not statistically significant. There was a trend to larger yield response in the crops not treated with fungicide, with the later timed nitrogen split of GS26/33 giving greatest advantage in both varieties compared to the seedbed/GS26 split.

**Quality**

There were two significant differences in grain quality from this trial (Table 7):

- lower screenings from Baudin (mean 1.8%) compared to Gairdner (mean 5.0%)
- higher proteins with later applied nitrogen leading to a reduced malting grade (GA3) compared to the pre-stem elongation split which produced proteins less than 12%

**Table 7:** Protein (%) associated with individual nitrogen and fungicide treatments (malt grade)

| Nitrogen regime | Fungicide treatment. | % Protein | |
|---|---|---|---|
| | | **Baudin** | **Gairdner** |
| Seedbed + GS25-30 | Impact | 11.7 (BA1) | 11.7 (GA1) |
| | Impact f.b. Opus | 11.6 (BA1) | 11.6 (GA1) |
| | Opus | 11.5 (BA1) | 11.6 (GA1) |
| | Untreated | 11.7 (BA1) | 11.7 (GA1) |
| | **average** | **11.6 (BA1)** | **11.6 (GA1)** |
| GS25-30 + GS33 | Impact | 11.9 (BA1) | 12.2 (GA3) |
| | Impact f.b. Opus | 12.3 (feed) | 12.3 (GA3) |
| | Opus | 12.3 (feed) | 12.4 GA3) |
| | Untreated | 12.3 (feed) | 12.1(GA3) |
| | **average** | **12.2 (feed)** | **12.2 (feed)** |

## Interpretation

In this trial where malting barley was grown with 100 kg/ha N applied, later timed nitrogen (split 50/50 between growth stages GS26 & GS33) produced either lower grade malting samples or feed samples. These timings were less profitable than a 50/50 split with nitrogen applied at sowing and again in late tillering - GS26.

Growing the crop with earlier applied nitrogen increased disease pressure due to greater canopy density – in this instance a fungicide improved the yield of Baudin. However the margin advantage with fungicide application in Baudin was very small and variable depending on treatment, when nitrogen was applied early (-2 to 6$/ha).

With the more resistant variety Gairdner, while there was a small response to fungicide when the crop was subject to early applied nitrogens the response was insufficient to pay for the fungicide (Table 8).

Baudin was slightly more profitable to grow since it was slightly higher yielding when fungicide treated than Gairdner and attracted a very slight premium.

While delaying nitrogen until stem elongation reduced the need for fungicides, it also reduced malting quality and therefore grain price – an effect which was much greater than the savings in fungicide costs.

**Table 8:** Value of output ($/ha) after fungicide costs have been removed.

| Nitrogen regime | Fungicide treatment. | Output after fungicide cost ($/ha) | |
|---|---|---|---|
| | | **Baudin** | **Gairdner** |
| Seedbed + GS25-30 | Impact | 762 | 711 |
| | Impact f.b. Opus | **766** | 715 |
| | Opus | 757 | 692 |
| | Untreated | 760 | **745** |
| | **average** | **761** | **715** |
| GS25-30 + GS33 | Impact | **763** | 703 |
| | Impact f.b. Opus | 691 | 698 |
| | Opus | 697 | 690 |
| | Untreated | 725 | **754** |
| | **average** | **719** | **711** |

**NOTES:** Output value takes account of application cost ($3.50/ha) and wheel track damage (2.5%). Grain is priced with GA1 $138/t, GA3 $135/t, BA1 $140/t and feed at $130/t as grades outlined in Table 6.

## Commercial Practice

These results indicate the difficulty of pursuing canopy management with the use of nitrogen in malting barley, although there is evidence that applying nitrogen later may enable a reduction in fungicide use, delayed nitrogen will increase the protein content of the grain.

The results illustrate that while there was no yield disadvantage to applying nitrogen at stem elongation, it is imperative not to overfeed the yield potential, and thereby provide excess nitrogen which pushes the protein content above malting grade.

That stated, this work illustrates that given the appropriate nitrogen rate, later nitrogen application could still be employed to reduce disease pressure and fungicide costs.

The other important finding from this work is the indication that a more susceptible variety, given the appropriate level of input, can produce greater margins than more resistant varieties.