# Barley Agronomy – nitrogen management in new barley varieties

Southern Barley Agronomy Project, funded by GRDC

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**Key findings**

- Varieties responded similarly in yield and all quality parameters to applied N. Variety choice played a more important role on overall yield and quality than N management:
- Averaged across all N treatments Fathom yielded highest at 3.30t/ha, and late maturing variety Wimmera the lowest at 2.47t/ha
- No applied N, yielded 2.88t/ha, while 40kgN, applied at GS30, yielded 3.12 t/ha.
- Using the Greenseeker, improved agronomic N efficiency by more than 50% over all other N treatments

**Why do the trial?**

To examine the nitrogen responses of new malt and food barley varieties and determine appropriate N management strategies for maximum yield and quality.

**How was it done?**

**Plot size:** 1.4m x 10m

**Fertiliser:** DAP (18:20) + 2% Zn @ 70kg/ha

**Seeding date:** 1st June 2012

**Deep Soil N Test:** 65kg available N/ha

The trial was a randomised complete block design consisting of 3 replicates, 7 barley varieties and 6 nitrogen treatments:

6 nitrogen treatments (applied as urea), 100% = Urea @ 170kg/ha (80kgN/ha)

1. No applied N (nil)
2. 50% (40kg N) IBS (incorporated by sowing)
3. 100% (80kg N) IBS
4. 100 % (80kg N) GS30
5. 50% (40kg N) GS30
6. 12% GS30 (10kgN/ha) - Optical sensor (as determined by GreenSeeker)

**Results**

**Early Growth responses**

The initial deep soil N level was relatively low at 65kg N/ha which suggested there was likely to be an N deficit in targeting a 3.5 t/ha yield. The 50% and 100% N IBS treatment were used in each variety as an N-rich reference (measure of N response) treatment for the Green Seeker NDVI crop sensor. Relative to unfertilized treatments, both N rates (IBS) measured with a Greenseeker at GS22 produced no significant response to N but showed a 7% response at GS30. All varieties responded similarly at GS30 (table 1).

*Table 3. Early season measurement of NDVI (GreenSeeker) and response to N at GS22, and GS30 in the unfertilised, and N rich plots applied with 40kgN, & 80kg N incorporated by sowing.*

| | NDVI GS22 | % Response | NDVI GS30 | % Response |
|---|---|---|---|---|
| No applied N (un-fertilized) | 0.476 | - | 0.699 | - |
| 50% IBS (N – rich strip) | 0.482 | 101 | 0.748 | 107 |
| 100% IBS (N – rich strip) | 0.484 | 102 | 0.745 | 107 |

**Optical sensor N rate calculations:**
Based on an initial estimated 3.5t/ha yield potential, a 7% response from applied N at GS30 (N rich strip) assumes an extra 0.24t/ha can be achieved with applied N. Barley requires approx 1.61 kg N/tonne/% protein, therefore to grow an extra 0.24t/ha of barley at 10.5% protein will require 4kg N/ha. Since N applied at GS30 typically has an N use efficiency of 40%, the final N rate to achieve theoretical optimal yield is 10kgN/ha (22kg/ha Urea).

**Grain Yield**
Varieties responded similarly in yield to applied N. The no applied N treatment (2.88t/ha) and the 50% IBS treatment yielded similarly while all other N treatments yielded higher, ranging from a 5% yield response in the optical sensor method to 9% when 50% was applied at GS30. Similar yields were achieved in treatments 3 – 6, but with varying N application rates. Calculation of agronomic N use efficiency (kg grain per kg N applied), found that use of the Greenseeker for optimal N management produced 13kg grain per kg N compared to less than 6 kg/kgN for all other treatments (Table 2).

The effect of variety was greater than the effect of N on grain yield (Table 3) with Wimmera, a late maturing variety, yielding lowest at 2.47t/ha and Fathom, a new early to mid maturing variety, yielding 3.30t/ha. Between these varieties, Skipper, Hindmarsh, and IGB1101 all yielded similarly, and these led Commander and Buloke.

*Table 4. The main effect of N treatments (100% = 80kg N/ha) on grain yield, agronomic N efficiency, and grain quality parameters average across all varieties at Hart, 2012.*

| N treatment | | Grain yield (t/ha) | AE* (kg grain/kgN) | Retention (>2.5mm) | Screenings %<2.2mm | Test weight (kg/hL) | Protein (%) |
|---|---|---|---|---|---|---|---|
| 1. | No applied N (nil) | 2.88 | - | 33.3 | 12.1 | 71.2 | 11.7 |
| 2. | 50% IBS | 2.93 | 1.2 | 23.5 | 16.9 | 70.8 | 13.2 |
| 3. | 100% IBS | 3.07 | 2.4 | 22.2 | 21.9 | 70.1 | 13.3 |
| 5. | 50% GS30 | 3.12 | 6.0 | 21.5 | 19.5 | 70.4 | 13.5 |
| 4. | 100 % GS30 | 3.05 | 2.1 | 19.6 | 21.0 | 70.2 | 14.8 |
| 6. | 12% GS30 (Sensor) | 3.01 | 13.0 | 22.6 | 16.6 | 70.6 | 13.2 |
| LSD (5%) | | 0.10 | | 4.1 | 4.2 | NS | 1.2 |

*AE = Agronomic N efficiency = net increase in grain yield per kg N applied

**Grain Quality**
Varieties responded similarly to applied N for all grain quality parameters. Additional N reduced grain plumpness (retention) by an average 11% across all rates and timings and increased screening levels by 7% compared to the nil control (Table 2). Protein levels were also increased by N rate and later timing. Test weights were similar across all N treatments.

Varieties differed significantly for each quality parameter.(Table 3). Fathom produced the plumpest grain along with the lowest levels of screenings. Among the malt varieties, Commander had the best retention and lowest grain screening levels. Hindmarsh and IGB1101 were similar across all parameters. Fathom produced the lowest test weight at 69.8 kg/hL, and Wimmera the highest at 72.6 kg/hL, all other varieties were similar at 70.1 kg/hL. Varieties differed significantly in grain protein and differences did not correlate well with varietal yield differences ie yield dilution effect. For example Buloke and Commander were amongst the lower yielding varieties but also had the lowest proteins.

*Table 5. The main effect of varieties (100% = 80kgN/ha) on grain yield, agronomic N efficiency, and grain quality parameters averaged across all N treatments at Hart, 2012.*

| Variety | Grain Yield (t/ha) | Retention (>2.5mm) | Screenings %<2.2mm | Testweight (kg/hL) | Protein (%) | Protein Yield (kg protein/ha) |
|---|---|---|---|---|---|---|
| Buloke | 2.79 | 14.1 | 19.4 | 70.2 | 12.8 | 35.6 |
| Commander | 2.96 | 30.5 | 14.7 | 70.5 | 12.8 | 38.0 |
| Fathom | 3.30 | 42.1 | 10.1 | 69.8 | 13.0 | 42.8 |
| Hindmarsh | 3.15 | 17.5 | 23.3 | 70.1 | 13.2 | 41.6 |
| IGB1101 | 3.19 | 17.1 | 22.5 | 70.2 | 13.0 | 41.1 |
| Skipper | 3.20 | 22.5 | 21.0 | 70.1 | 13.2 | 42.1 |
| Wimmera | 2.47 | 25.0 | 15.0 | 72.6 | 14.7 | 36.4 |
| LSD (5%) | 0.09 | 2.5 | 2.4 | 1.6 | 0.3 | 1.8 |

**Summary**

The results from this trial at Hart in 2012, indicate that current and emerging barley varieties respond similarly to N for grain yield or receival quality parameters. The dry finish to the season favoured earlier to mid maturing varieties. The predetermined N strategies of 40kg N and 80kg N led to an oversupply of N and decline in grain quality in all varieties. Besides over-application of N, high grain protein levels most likely arose from low rainfall after anthesis. This trial highlights the need for growers to address both N management and environmental uncertainties to produce profitable crops. While the effects of N rate and timing were significant, varietal choice played a greater role in overall yield and quality at this site in 2012. Growers should therefore consult the more extensive NVT data for information on varietal selection.

While no variety achieved malt specification in this trial, adopting a sensor-based or equivalent strategic approach may facilitate better fertiliser N decisions mid-season, since real time crop measurements taken during the season can indicate how much N has been delivered from the environment (i.e. mineralisation, background N). The results suggest that while soil testing was informative, applying a static value to N demand, based upon an early season soil test is not necessarily a reliable method. At Hart background levels of N indicated low levels of N and there was expected to be a large response to N, an estimate of 80kg N/ha was calculated to sustain a 3.5t/ha crop. However, the in season measurement of N response (using the Greenseeker sensor) showed no response to N at GS22, and only a small response at GS30, indicating the environment had delivered a large amount of N through mineralisation or that there is spatial variability in soil N at the site. Given the lack of in season N response, a much lower rate of 10kgN at GS30 was needed to achieve similar yields to the predetermined values of the 40kg and 80kg N strategies. Using a Greenseeker optical sensor for N management, improved the agronomic N use efficiency by more than 50% above all other N treatments.

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