



Tactical nitrogen decisions for wheat

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Purpose:	Demonstrate and evaluate nitrogen-rich strips (N Gauges) and Normalised Difference Vegetation Index (NDVI) measurement as to provide a simple, accurate and easy-to-understand decision support tool to guide economic application of nitrogen during the growing season.
Location:	WMG Trial Site: "Glen Ruff", Michael Brennan, Moora.
Soil Type:	Sandplain
Rotation:	2015 RR canola [GT50]; 2014 wheat; 2013 lupin.

Table 1. Soil Test Results

Depth	NO ₃ ⁻	NH ₄ ⁺	OC	P	PBI	K	S	Cu	Zn	pH _[Ca]	Al _[Ca]
0-10cm	16	4	0.69	18	18	24	7	0.39	0.78	4.7	1.5
10-20cm	8	3	0.42	22	26	18	5	0.40	0.31	4.5	4.9
20-30cm	4	2	0.20	7	29	15	7	0.26	0.20	4.4	7.1
30-50cm	3	2	0.00	2	0	16	12	0.00	0.00	4.5	5.3

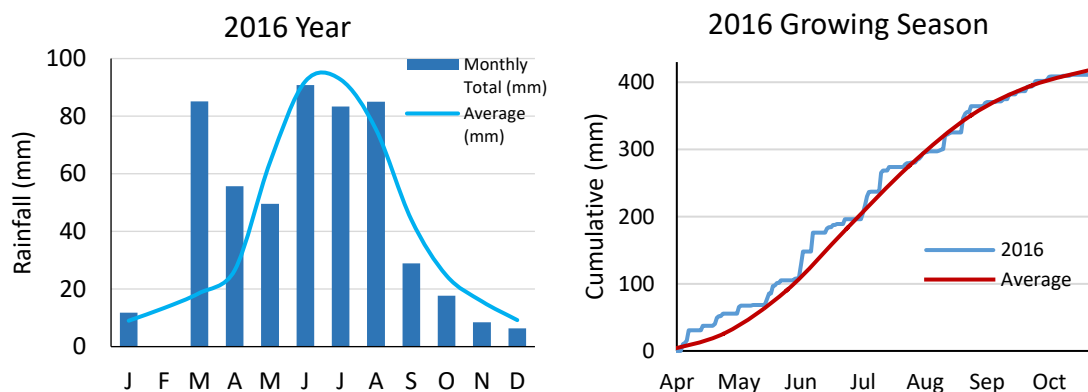


Figure 1. 2016 monthly rainfall data (mm) for Chelsea BOM Stn 9006, 10.5 km W of trial

BACKGROUND SUMMARY

Summit's In-Season Nitrogen Calculator aims to calculate a precise N rate to maximize yield potential of a paddock where a crop is starting to run into N limitations, using NDVI as a real-time growth measurement. It is designed to utilise comparisons between crop growth without N limitations beside paddock practice to determine optimal N application for yield and returns.

This trial is part of a series that aims to evaluate the accuracy of the N Calculator's recommended N rates and predictions of yield in various conditions and crops. The trial incorporated:

- i) plots with designated up-front N rates and an N-rich strip (N Gauge) for NDVI comparison;
- ii) replicated and randomised plots to apply a series of tactical N treatments based on the predictions of optimal N application determined by the Summit In-Season Nitrogen Calculator after Greenseeker® NDVI readings of the plots established at i);

TRIAL DESIGN

Plot size:	10 x 1.8 m
Machinery use:	Small plot seeder with knife points and press wheels
Repetitions:	3
Crop type and varieties used:	Mace wheat
Seeding rates and dates:	14/05/2016 at 80 kg/ha

Table 2. Fertiliser inputs and treatments

Tmt	N	Seeding Fertiliser product kg or L/ha	PSPE L/ha	4WAS Kg/ha	NDVI input into N Calculator for N rate recommendation 27/07/16
A	0	SSP 90, TSP 20, MOP 25		MOP 25	
B	30	Vigour 100, MAXamFLO 70		MOP 25	0.264 [#]
C	50	Vigour 100, MAXamFLO 70	UAN 50	MOP 25	
D	90	Vigour 100, MAXamFLO 70	UAN 150	MOP 25	
E*	120	Vigour 100, MAXamFLO 70	UAN 220	MOP 25	0.410

* N-Gauge

[#]Mean of all 30N up-front plots [B; 1; 2; 3]

RESULTS

At 10 weeks after sowing, using the NDVI assessment plot comparison, the In-Season Nitrogen Calculator:

- calculated an optimized N top-up application rate of 25 kg/ha (10.5% protein target) on plots with 30 kg/ha N applied at seeding;
- estimated that this application would achieve a 2 t/ha yield; and
- predicted this regime would out-yield a paddock with no N top-up by 690 kg/ha (Figure 2)

Top-up N treatments were applied, using the N calculator rate and each of +/- 50% of this rate (Table 3).

The screenshot shows a web-based N calculator interface. At the top, there is a navigation menu with links: HOME, GALLERY, CANOLA, WHEAT, BARLEY, CONTACT US, INFORMATION. Below the menu, there are logos for WHEAT, NEXUS, SUMMIT TOTAL QUALITY SERVICE, and SUMMIT FERTILIZERS. The main form contains several input fields with pre-filled values:

- Sowing Date: 14/05/2016
- Sensing Date: 27/07/2016
- Days from Sowing: 74
- NDVI Farmer Practice: 0.284
- NDVI N Rich Strip: 0.410
- Advisor Name: GHERARDI
- Grower Name: WMG TRIAL SITE 2016
- Site / Paddock Name: 30 N UP-FRONT PLOTS

A 'Calculate' button is located next to the Grower Name field. Below the input fields, a table displays the calculated results:

Estimated yield with decile 5 spring	1.939 t/ha
N fertiliser requirement	24.86 kgN/ha
11.5% protein	40.37 kgN/ha
12.5% protein	55.89 kgN/ha
Result from not applying N	1.249 t/ha

Figure 2. In-Season N Calculator input/output example for the N-gauge plot (E, 120 kg/ha N) versus treatment plots (1-6, 30 kg/ha N) NDVI comparison on 22/6/2016 – 61 days after sowing

Table 3. Establishment fertiliser and top-up nitrogen treatments after NDVI comparison (Table 2)

Tmt	Seeding N	Seeding Fertiliser product kg or L/ha	4WAS	In-season N rate determined by N Calculator		
				N kg/ha	UAN L/ha	
1	30	Vigour 100, MAXamFLO 70	MOP 25	N Calculator x 50%	12.5	30
2	30	Vigour 100, MAXamFLO 70	MOP 25	N Calculator x 100%	25	60
3	30	Vigour 100, MAXamFLO 70	MOP 25	N Calculator x 150%	37.5	90

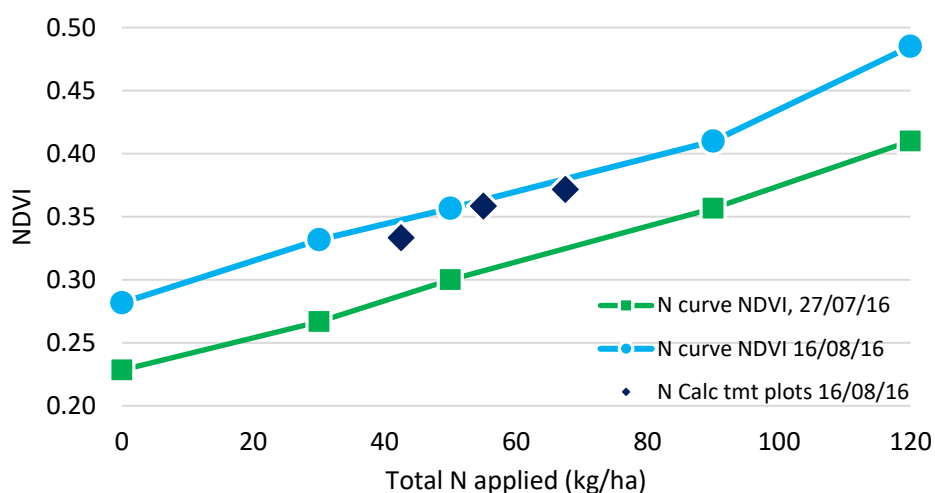


Figure 3. NDVI measured with a handheld Greenseeker® 74 days after sowing (27/7/2016) – used for input into In-Season N Calculator – and subsequently at 94 days after sowing

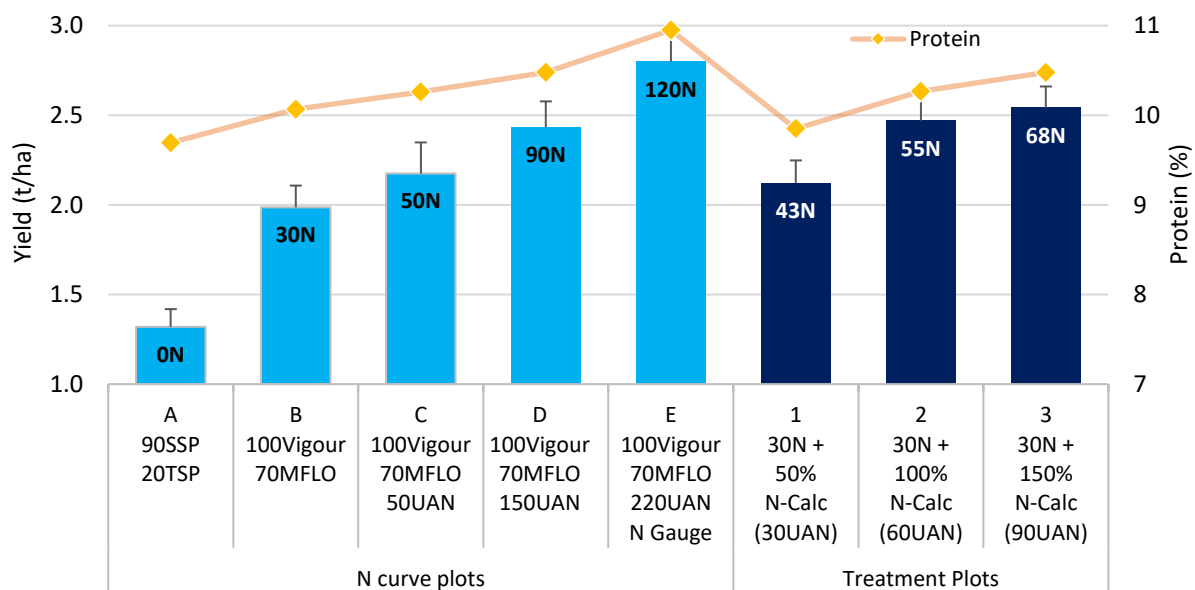


Figure 4. Yield and protein from increasing nitrogen up-front rates (left) and plots with different N-calculator rates of N applied (right). Bars are standard error

FINANCIAL ANALYSIS OF RESULTS

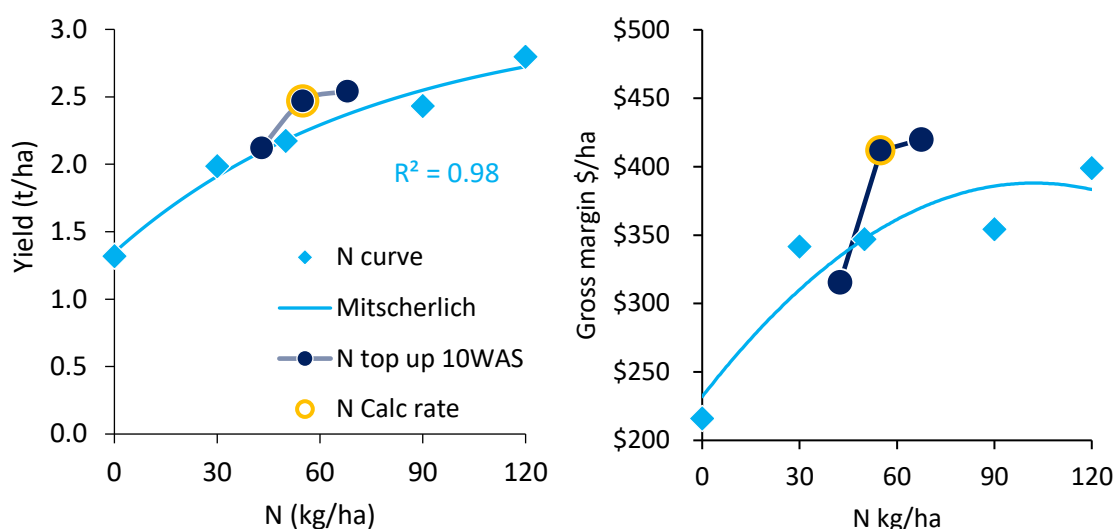


Figure 5. Yield response curve (left) for up-front N rate plots (Mitscherlich fitted) and gross margin curve (right, polynomial fitted) highlighting additional yield response and returns achievable by splitting N applications and using N Calculator recommendations

Table 4. Yield, grain quality and gross margin from wheat production net of total fertiliser input costs. Highlighted row indicates N Calculator recommended rate at 10 weeks after sowing

Tmt	Estab N [^] kg/ha	Top up N kg/ha	Timing	Fert # \$/ha	Yield t/ha	Protein %	H-litre	Screen %	Grade	Grain* \$/ha	Returns \$/ha
A	0	-	-	\$82	1.32	9.7	80.6	1.3	ASW1	\$298	\$216
B	30	-	-	\$145	1.99	10.1	80.6	1.2	APW1	\$487	\$342
C	30	20 [@]	Seeding	\$177	2.18	10.3	80.6	1.3	APW2	\$524	\$347
D	30	60 [@]	Seeding	\$241	2.43	10.5	80.7	1.1	APW1	\$596	\$354
E	30	90 [@]	Seeding	\$287	2.80	11.0	80.5	0.9	APW1	\$686	\$399
1	30	12	10WAS	\$164	2.12	9.9	80.3	1.3	ASW1	\$480	\$315
2	30	25	10WAS	\$184	2.47	10.3	80.7	1.3	APW2	\$595	\$412
3	30	38	10WAS	\$203	2.54	10.5	80.6	1.3	APW1	\$623	\$420

Notes: All prices net delivered/received Kwinana and GST Exclusive

[^]Establishment N: Urea banded below seed

[@] Top up N: UAN applied to soil in furrow behind seeder (PSPE)

* Delivery grade \$/t Kwinana 14 December 2016: APW1 \$245, APW2 \$241, ASW1 \$226

Total of all fertilizer products applied. March 2016 retail price (ex Kwinana)

The N-calculator did a very good job of predicting an N rate that optimised yield and gross margin, with yield differences being significant when the recommended rate was altered. This has consistently been found for wheat and barley over recent seasons and, interestingly, in extending the Calculator to oat grain crops.

Using the In-Season N Calculator output:

- Application of 60 L UAN/ha at 10WAS as recommended by the In-Season Nitrogen Calculator produced 2.5 t/ha yield.

- Increasing the application rate by 50 % achieved negligible increase in yield (+70 kg/ha) but decreasing the application rate by 50 % meant a significant yield penalty (-350 kg/ha).
- In-Season Nitrogen Calculator produced grain with protein content 10.3%, very close to the target 10.5%.
- The yield penalty estimation of 680 kg/ha for no N top-up application was overestimated compared with the actual measured 480 kg/ha difference.

The robustness of the In-Season N calculator model is further confirmed when the top-up N treatment data are plotted at the same time as yield data from up-front N response data (Figure 5). Yields from N calc recommendations fall at or near the inflection point of the standard up-front N rate response curve, indicating that rate recommendations were very close to optimal for yield production. The lift of yield above the stand N curve shows the value in split-rate N applications, taking advantage of seasonal conditions and timing, and also informed by the crop capability as assessed by NDVI comparison and the N calculator model.

Grain quality analysis showed high hectolitre weights and low screenings. Protein was reasonable but not high. Therefore, indicative delivery grades achieved were APW – ASW.

Based on the yield and delivery grade, when calculated gross margins net of all fertiliser at March 2016 list price were compared to a \$342/ha return with only 30 kg/ha N applied at seeding, top-up N at model recommended rates indicatively returned an additional \$70/ha. Decreasing or increasing the model rate by 50 % resulted in -\$27/ha and +\$78/ha compared with the 30 kg/ha N standard. This highlights the importance of getting N application decisions right and how simple and effective decision support tools can help to avoid under or overspending on mid-season N.

CONCLUSIONS:

- For this trial, the N-calculator prediction optimised yield and gross margin in Mace wheat.
- In Season N Calculator model predictions were
- Getting mid-season N decisions right can have a significant impact on profitability since optimal top up N rates indicatively increased yields by 480 kg per hectare and net returns by \$70 per hectare.
- The value of split N applications was shown and the trial provides more weight to the building confidence that the N calculator can provide real and robust N recommendations that are not in excess of crop requirement and produce maximum or near maximum margin returns from mid-season N applications.

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