Assessing Yield Prophet as a tool to assist growers in determining crop nitrogen requirements in the West Midlands

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11WMG05

Purpose:	The trial seeks to test the Yield Prophet tool to determine its relevance and usefulness to growers of the West Midlands region in determining the most efficient and effective nitrogen strategy
Location:	Badgingarra
Soil Type:	Duplex sandy gravel
Soil Results:	Table 1
Rotation:	2010 Canola; 2009 Wheat; 2008 Lupins; 2007 Oats
GSR:	485 mm

Table 1: *Soil Test Results*

Element	Topsoil 0-10 cm	Subsoil 10-40cm	
Nitrate N	9	2	mg/kg
Ammonium N	3	0	mg/kg
P	23	13	mg/kg
K	149	36	mg/kg
S	22	8	mg/kg
OC	1.4	0.61	%
Zn	0.74	0.05	mg/kg
PBI	16	20	
EC	0.13	0.03	dS/m
pH	6.5	5.3	(CaCl2)
Al	0	0.8	mg/kg
Gravel	40	60	%

BACKGROUND

The trial examines and compares three Nitrogen strategies (see below) over two wheat varieties (Bonnie Rock and Mace) at two times of sowing. N strategies as follows:

- Strategy 1: Farmer Practice - growers used same decision making process as they would for their own crops to determine N strategy for each treatment. Target yield at the start of the season was 4t/ha, to be adjusted as the season developed.
- Strategy 2: Farmers used reports from Yield Prophet to assist decision making - decision made a week prior to expected time of actual application. Nitrogen to be applied when the model suggested a gap between yields from current plant available N, and that of an unlimited N situation.
- Strategy 3: Control strategy - growers determined a standard N application strategy prior to seeding, based on soil test results with a 4t/ha yield target. Application rates & timing were consistent for all treatments.

This trial was undertaken in WMG in 2010 at an adjacent location. Due to timing the soil was unable to be fully classified in Yield Prophet for 2010, however for this trial (in 2011) full soil characterization was conducted prior to seeding and Yield Prophet was calibrated accordingly.

TRIAL DESIGN

Plot size: 1.8 x 20m

Repetitions: 3

Crop details: EGA Bonnie Rock and Mace Wheat @ 75kg/ha

Seeding date: **TOS 1**: 19 May 2011

TOS 2: 7 June 2011

Seeding Fertiliser: MAPSZC 100kg/ha (11kg N/ha)

Herbicide: **TOS1 & TOS2** Pre Sowing -18 May: Talstar @ 200mL/ha; Dominex @ 100mL/ha; Sprayseed@ 1.5L/ha; Treflan @ 1.5 L/ha

TOS1 Post Emergent - 13 June: Ally @ 2.5Gm/ha; Lontrel @ 200 mL/ha; Barracuda @ 0.75 L/ha

TOS2 Pre Sowing - 7 June: Talstar @ 200mL/ha; Dominex @ 100mL/ha; Sprayseed@ 2L/ha; Treflan @ 1.5 L/ha

TOS1 & TOS2 Post-emergent:

22 June: Hasten @ 0.1L/ ha; Decision @ 1L/ha

5 July: Lontrel @ 200 mL/ha; Barracuda @ 0.8L/ha

14 July: Hoegrass @ 0.8L/ha

19 July: Barracuda @ 0.8 L/ha

Nitrogen management

Post seeding nitrogen applications were broadly targeted at plant growth stages, but timing was fine tuned with regard to weather conditions and rainfall forecasts (Figure 1).

TOS1 (19 May)

Table 2A: TOS1- *Timings and rates of nitrogen applied to TOS1*

Date	**YP Strategy** (kg N/ ha)	**Farmer Strategy** (kg N/ ha)	**Control Strategy** (kg N/ ha)
19 May (at seeding)	11	11	11
22 June	30	30	50
3 August	10	20	40
Total N applied	**51**	**61**	**101**

TOS2 (7 June)

***Table 2B: TOS 2**- Timings and rates of nitrogen applied to time of sowing two plots*

Date	YP Strategy (kg N/ ha)	Farmer Strategy (kg N/ ha)	Control Strategy (kg N/ ha)
7 June (at seeding)	11	11	11
12 July	50	30	50
3 August	20	30	40
Total N applied	**81**	**71**	**101**

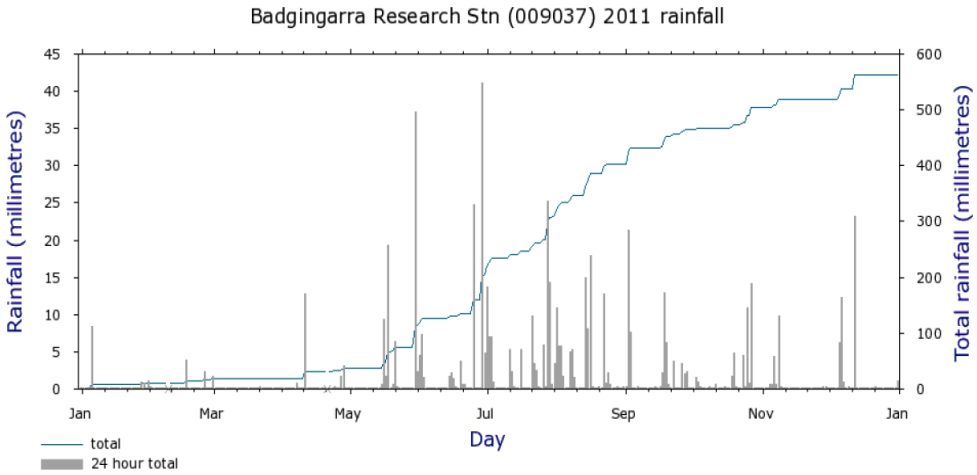

***Figure 1:** Badgingarra Research station (site 009037) 2011rainfall. Source-Bureau of Meteorology*

RESULTS & DISCUSSION

Plant establishment counts were taken on TOS1 and TOS2 plots on 7th June and 29th June respectively, prior to the first nitrogen application for each TOS. Average plant numbers per meter row were 27 and 21 respectively, with no significant different between variety treatments in each time of sowing. Conditions after seeding for TOS2 were relatively dry and cold, so there may have been some delayed emergence of the crop.

Suspected herbicide resistance and a high background population resulted in strong competition from ryegrass in TOS1 plots. This appeared to significantly reduce tillering across the site, highlighted by differences between TOS treatments in pre-harvest head counts (Fig.2). A more effective knockdown and better pre-emergent selective chemical efficacy was noticed in TOS2 plots, although ryegrass competition would likely still have been a minor factor in limiting yield.

Figure 1 shows results of head count measurements conducted in the Mace plots on 13 October of both TOS1 and TOS2. The significant difference in TOS1 vs TOS 2 head counts in all N strategies illustrates the degree to which TOS1 plant growth was impacted by weed competition.

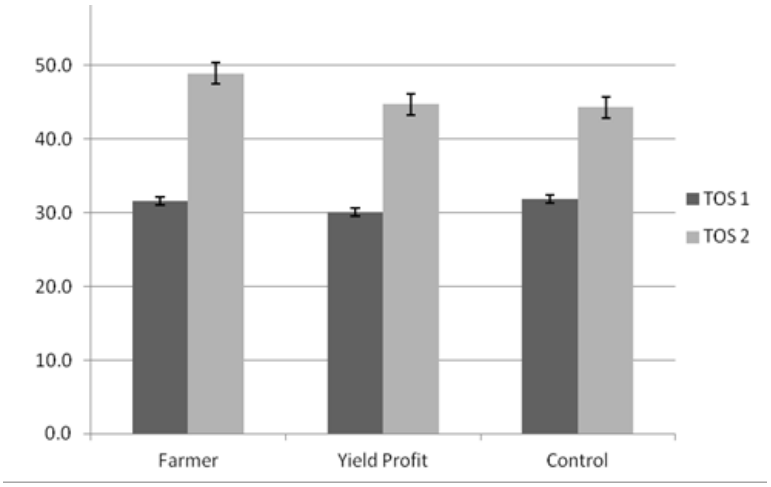

Figure 2: *Head counts per metre row at 13 October 2011(Error bars are standard errors)*

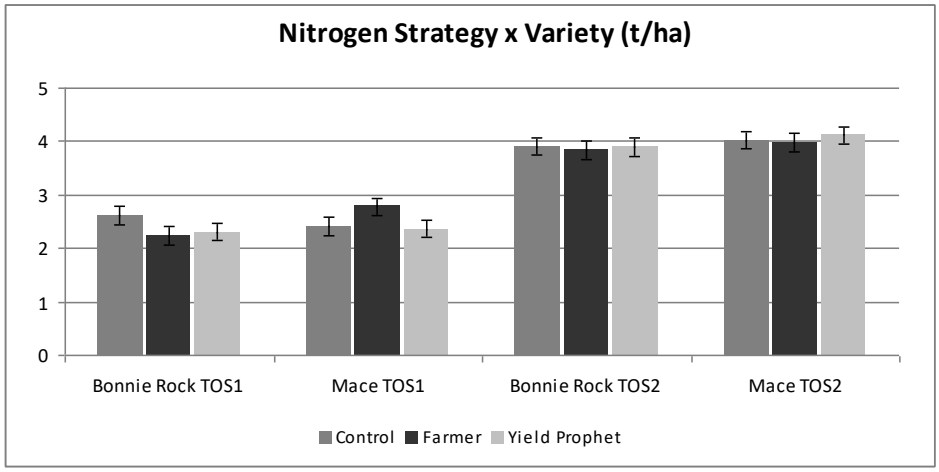

Figure 3: *Grain yield results (t/ha) for TOS1 and TOS2 comparing three Nitrogen Strategies and two wheat Varieties (error bars indicate significant difference P=0.10)*

Table 3: *Grain Yield results (t/ha) of three Nitrogen Strategies across two sowing times and varieties (different letters in the last column indicates treatments that differ significantly)*

Variety	Sowing Time	N Strategy	Yield (t/ha)	
Bonnie Rock	TOS1	Farmer	2.24	d
Bonnie Rock	TOS1	Yield Prophet	2.31	cd
Bonnie Rock	TOS1	Control	2.62	bc
Mace	TOS1	Farmer	2.78	b
Mace	TOS1	Yield Prophet	2.36	cd
Mace	TOS1	Control	2.41	cd
Bonnie Rock	TOS2	Farmer	3.84	a
Bonnie Rock	TOS2	Yield Prophet	3.90	a
Bonnie Rock	TOS2	Control	3.90	a
Mace	TOS2	Farmer	3.99	a
Mace	TOS2	Yield Prophet	4.12	a
Mace	TOS2	Control	4.02	a
		CV	***7.37***	
		LSD (P=.10)	***0.33***	

TOS2 grain yields were significantly higher than TOS1 across all Nitrogen strategies and both varieties (Table 3), indicating the impact that the early ryegrass competition had on TOS1 treatments.

There was no significant difference between any treatments in TOS2.

In general there was no difference between varieties within TOS or nitrogen strategy treatments, except for the Farmer strategy in TOS1, where Mace out yielded Bonnie Rock by 0.64t/ha. This result stands out as there were no other trends towards one variety out yielding the other in any other treatments. This is in contrast to the 2010 trial, where Mace significantly out yielded Bonnie Rock across all Nitrogen Strategies and both TOS.

In TOS1, the Bonnie Rock Control strategy significantly out yielded the Farmer strategy by 0.38t/ha (Table 3). The Control strategy received an extra 40kg N/ha (101kg vs 61kg). The extra nitrogen applied during a period of high rainfall and low N efficiency (late June-mid August, Figure 4) could explain this difference, however the Yield Prophet strategy had the same N applications during this period, and although there was a trend towards a yield difference between Control and Yield Prophet, it was not significant.

In TOS1, Mace Farmer strategy significantly out yielded Control and Yield Prophet by 0.37t/ha and 0.42t/ha, respectively (Table 3), even though the Farmer strategy nitrogen rates were barely more than the Yield Prophet (61kg vs 51kg/ha), and was much less that the Control (101kg/ha).

Calibration of Yield Prophet to local conditions

The more historical yield data Yield Prophet has available to it the more accurate the tool becomes as it better calibrates to local conditions. Table 4 shows the variation between Yield Prophet simulated yields for TOS2 (for the applied nitrogen) and the actual yield harvested. Only TOS2 is shown as weed competition on TOS1 significantly impacted yield and Yield Prophet does not have the capacity to take into account impacts of weed control.

Table 4: *Yield Prophet model forecasted yields of TOS2 compared to actual yields of TOS2 plots.*

	Yield Prophet forecast at harvest (t/ha)	**Actual Yield** (t/ha)
TOS2 Bonnie Rock	4.6	3.9
TOS2 Mace	4.6	4.1

Yield prophet did not show any differences in yield between the two varieties in reports throughout the season. Although there was no significant difference in harvest yields between the varieties, there was a trend towards Mace out yielding Bonnie Rock across all nitrogen strategies.

The Yield Prophet forecast should be considered reasonably accurate, given that there could be other factors limiting top end yield.

- Weed competition, whilst not as significant as in TOS1 treatments, would still have been a minor limiting factor.
- Given the difference in applied nitrogen between treatments, the relatively even yields suggests nitrogen wasn't the limiting factor at this site, this year
- The soil type is known to be phosphorus responsive, and even though there were 20kg/ha applied P, the Yield Prophet forecast was above the target yield, and as such P (and possibly other nutrients), may have been limiting.

Financial analysis

The 'nitrogen profit' report from Yield Prophet allows the user to compare the profitability of different nitrogen strategies throughout the season (as opposed to the highest yielding nitrogen strategy).

Basic financial analysis (Table 5) revealed that Yield Prophet nitrogen strategy was the most profitable at the later sowing date of TOS2.

In TOS1 the Farmer N strategy was the only strategy that had the ability to take into account the weed burden issue when planning their N strategy. Although the Farmer N strategy was the most profitable at this Time of Sowing in Mace it was the least profitable for Bonnie Rock.

Table 5: *Financial analysis of N strategies of TOS1 and TOS2 impact of nitrogen cost on per hectare profit.*

	Farmer N Strategy			**YP N Strategy**			**Control N Strategy**		
	Yield (t/ha)	**Total N cost*** ($/ha)	**Gross income** after N costs** ($/ha)	**Yield** (t/ha)	**Total N cost** ($/ha)	**Gross income after N costs** ($/ha)	**Yield** (t/ha)	**Total N cost** ($/ha)	**Gross income after N costs** ($/ha)
TOS1 Bonnie Rock	2.2	$97.25	$430.75	2.3	$84.75	$467.25	2.6	$147.25	**$476.75**
TOS1 Mace	2.8	$97.25	**$574.75**	2.4	$84.75	$491.25	2.4	$147.25	$428.75
TOS2 Bonnie Rock	3.8	$109.75	$802.25	3.9	$122.25	**$813.75**	3.9	$147.25	$788.75
TOS2 Mace	4	$109.75	$850.25	4.1	$122.25	**$861.75**	4	$147.25	$812.75

** Cost of N based on $1.25/kg of Nitrogen and application cost of $7/h; **Gross income calculated on $240/tonne of wheat. Cost of application= $7/ha*

CONCLUSIONS

- The high ryegrass burden, particularly on the TOS1 plots impacted on the usefulness of the yield prophet tool for this time of sowing as it does not take into account other yield limiting factors.
- High rye grass burden on TOS1 had significant impact on yield (approx 1.2-1.3 t/ha). As such we have learnt that site selection (most especially with herbicide resistant weeds) is critical in order to conduct meaningful trials.
- No difference in Yield Prophet forecasts between the two cultivars Mace and Bonnie Rock. This was also expressed in the harvest results, in direct contrast to the very dry, early finishing 2010 season, where Mace out yielded Bonnie Rock in all treatments.
- In a season where there was little difference between any of the nitrogen strategies, the Yield Prophet tool has proven to be at least as effective as any other method of assessing nitrogen requirements and yield potential. As measured by returns per hectare (Table 5), the Yield Prophet Nitrogen Strategy ranked 1st or 2nd for each variety/TOS.

REVIEWED: Ben McTaggart

ACKNOWLEDGEMENTS

This trial was part of the Birchip Cropping Group's National Adaptation & Mitigation Initiative funded by GRDC and Australian Government's Climate Change Research Program. Thanks to working party of Jeff Fordham, Helen Lethllean, Ben McTaggart and Brett Beard. Thanks to Summit Fertilisers for soil and tissue testing.