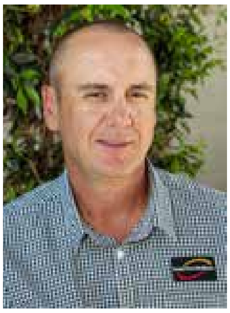
Topdressing trials and tribulations



By Lee Menhenett -Technical Agronomist

Topdressing nitrogen can be difficult to get right with respect to timing and rate.

Given that nitrogen is the biggest barrier to yield (except for moisture), it requires careful planning and management.

The basic fundamentals for nitrogen rate applications are:

1. Stored soil moisture
2. Crop rotation
3. Organic carbon
4. Seasonal outlook
5. Paddock disease/weeds status
6. Residual soil nitrogen post-harvest

This season in the Mallee, crops have generally had excellent soil moisture levels, but poor residual nitrogen levels (<20 kg/ha) from 2016. Although there has been an increase in legumes, organic carbon levels are still poor. Weeds and diseases will need to be assessed on a paddock by paddock basis.

As for the season, while it has been an average or below average winter so far, the outlook for spring is average to slightly drier.

Water Limited Yield (WLY) dictates the total amount of nitrogen which should be applied to a crop.

Stored moisture, in crop rainfall and post topdress seasonal rainfall scenarios are used to build a Water Limited Yield (Table 2).

The yield component of nitrogen budgeting is a flexible estimate, however bear in mind that in our nitrogen trials economic outcomes are often better when applying higher nitrogen rates than the optimum, rather than lower nitrogen rates. See financial tables.

The component to fix in budgeting for cereals is protein. Referred to as the critical protein percentage, it is the point at which grain yield is maximised.

By achieving a lower protein percentage in grain, it is reasonable to conclude that the crop ran out of nitrogen before it ran out of moisture.

Environmental and varietal factors can influence this rule, however for nitrogen budgeting purposes it is a solid platform.

The graphs below show that maximum yield is produced with protein values around 11%. While this protein percentage can vary to be slightly higher or slightly lower, as a broad indicator, setting APW as a grain delivery standard is a good way to achieve close to maximum yield.

Dry hotter seasonal finishes may see smaller, higher protein grains while a cooler, wetter finish may see larger grain sizes with higher yields and lower protein.

Setting a critical protein value allows yield to flex in different seasons.

Water Limited Yield = (Stored Moisture* + Growing Season Rain) – 110 mm non-productive moisture

*30% of effective (i.e. >20mm) summer rainfall events

Nitrogen crop budgets

N Requirement = Yield x Protein x Protein factor x Efficiency

For example, if a growers was targeting a 3 t/ha wheat crop, the equation to determine the nitrogen requirement would be: 3 x 11 x 1.75 x 2.5 = 144 kg/ha of nitrogen.

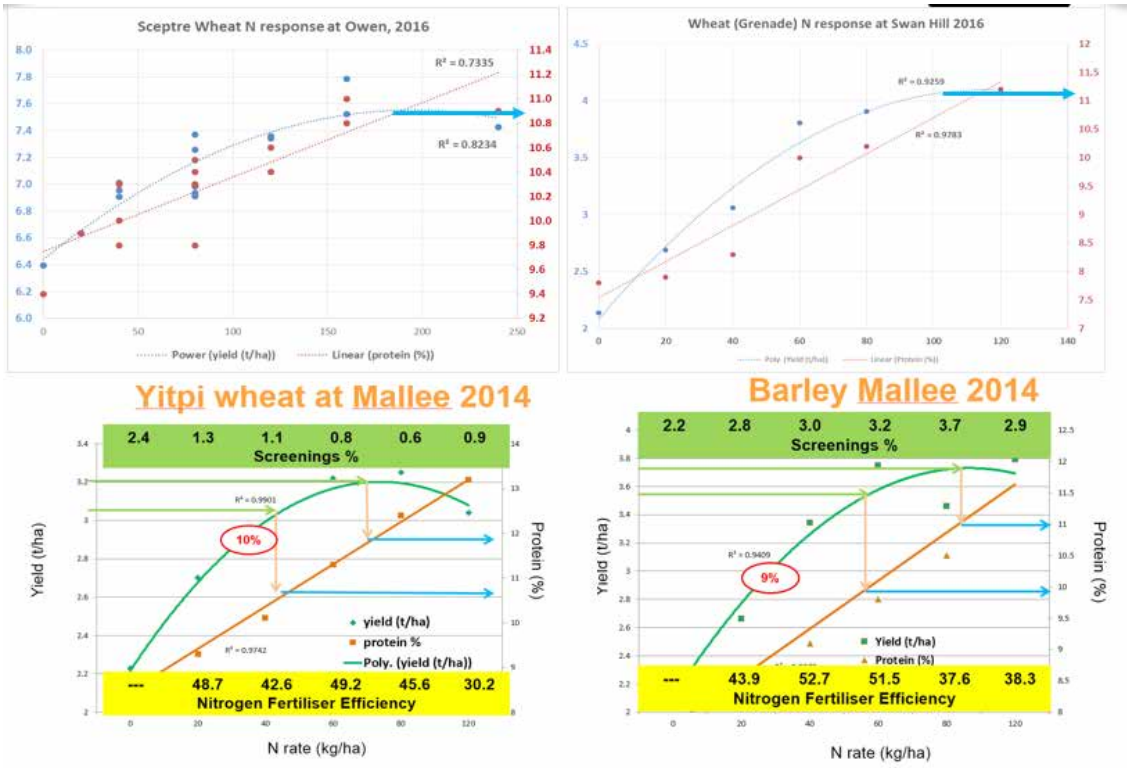
Then it would be necessary to deduct any soil mineral nitrogen to rooting depth and any in crop mineralisation.

Table 1: Guide to nitrogen budgeting in the Mallee

	Wheat	Barley	Canola
Protein %	11-11.5	10.5	18-24%*
Protein factor	1.75	1.6	1.6
Efficiency	40-45% (2.5-2.22)	45-50% (2.22-2)	33% (3)

*Source: Incitec Pivot Fertilisers, 2017 *Canola protein + oil = 63-68% i.e. higher protein/lower oil - season, N rate and variety dependent*

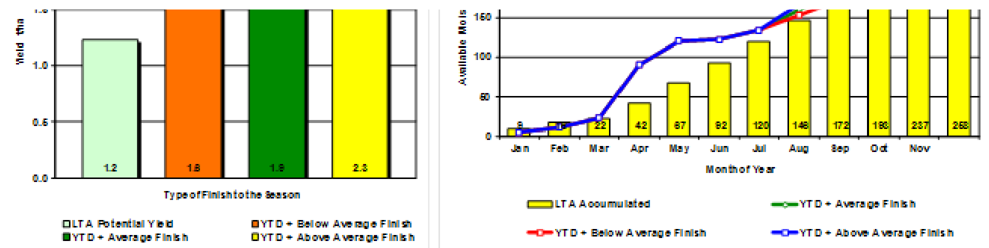
The relationship between grain yield and protein



Source: Incitec Pivot Fertilisers, 2017. Note: 2014 trials were conducted in Beauchamp, Victoria.

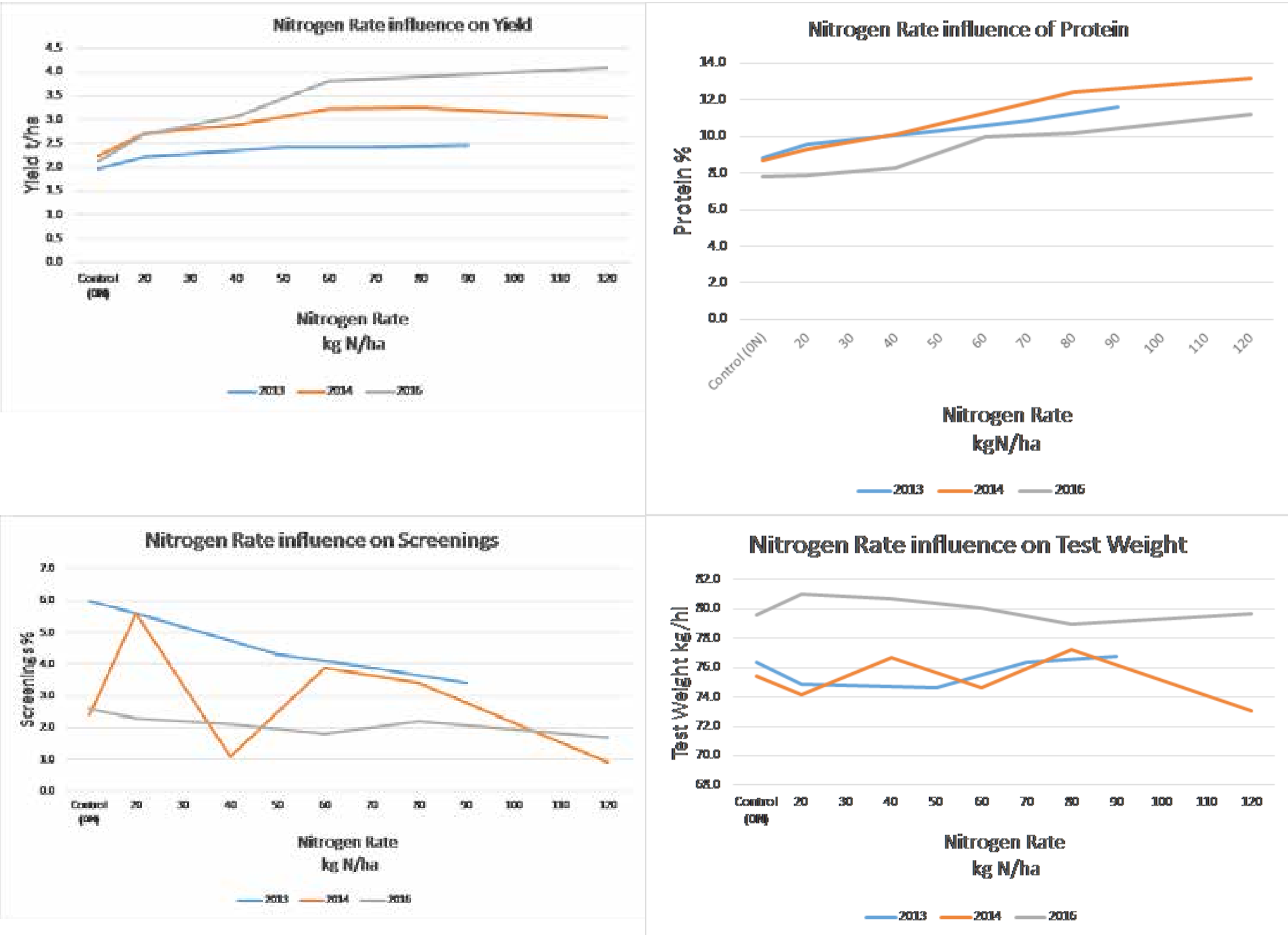
Table 2 - Water limited yield predictions and associated nitrogen requirements for wheat at Swan Hill

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Growing season rainfall	Water limited yield prediction
Long term average (LTA)	27	22	17	20	25	26	28	26	26	22	43	21	172	
LTA accumulated	9	16	22	42	67	92	120	146	172	193	237	258		1.2 t/ha
Actual monthly rainfall	13	20	34	68	30	2	12	0	0	0			111.8	
Available moisture	4	7	11	90	120	122	134	134	134	134				
YTD + below average finish	4	7	11	68	30	2	12	19	20	16			189	1.6 t/ha
YTD + average finish	4	7	11	68	30	2	12	26	26	22			207	1.9 t/ha
YTD = above average finish	4	7	11	68	30	2	12	32	33	27			226	2.3 t/ha



*Source: Incitec Pivot Fertilisers, 2017. *Assumes 20 kg grain/mm moisture and evaporation of 110 mm.*

The relationship between grain yield and protein



Source: Incitec Pivot Fertilisers, 2017. Trials were conducted in Beauchamp in 2013, Beauchamp in 2014 and Nyah West in 2016.

So how late can nitrogen be topdressed in the Mallee environment?

Generally, there is no willingness to apply nitrogen after early to mid August.

At this time, crops are generally from GS31 to 39, or an early sown crop could be as advanded as GS45, so the yield penalties as described above have already occurred if no nitrogen has been applied.

If some nitrogen fertiliser (20-40 kg/ha of nitrogen) has been applied prior to GS31, then it is still possible to influence yield if there is good stored moisture and a reasonable rainfall event to take the nitrogen into the soil and maintain plant root activity in the top 30 cm.

Haying off and subsequent high screenings are generally associated with large amounts of nitrogen during the early vegetative stage of crops, causing excessive tillering and biomass production.

It could be argued that at the lower sowing rates and the use of short season wheat varieties with lower tiller numbers in the Mallee environment decreases this risk.

The risk is also lowered due to the region’s very low mineralisation potential, low soil mineral nitrogen this season and the fact that early nitrogen applications, such as at sowing or early tillering, provide parity yields with splits in our trials.

Applying nitrogen from GS31 to 45 should not cause an increase in screenings. If there happens to be minimal or no rainfall until crop maturity, the majority of that applied nitrogen would still reside in the soil for the subsequent crop.

As a general rule for the Mallee, 40 kg/ha of nitrogen is the base rate for below average seasons, 40-60 kg/ha of nitrogen for average seasons and 60-80 kg/ha of nitrogen for above average seasons.

The financial tables shown below highlight this point and also indicate that applying above the optimum financial yield is often better than under applying nitrogen.

The risk is not getting enough nitrogen on the crop, rather than over applying.

The tables below summarise the trial data from 2013, 2014 and 2016, including $/ha return net of fertiliser cost.

Yield and estimated net returns in wheat at Beauchamp in 2013

Treatments	N applied (kgN/ha)	Yield (t/Ha)	Protein %	Screen %	Test wt (kg/hL)	Grade	Price ($/tonne)	Gross returns ($/ha)	N cost ($/ha)	$/ha net of N cost v control	Risk reward ratio
Control	0	1.97	8.8	6.0	76.4	AGP1	$221	$436	$0	$0	$0.00
Urea 23	23	2.21	9.6	5.6	74.9	AGP1	$221	$488	$31	$21	$1.69
Urea 0+23N	23	2.12	9.5	5.4	76.7	AGP1	$221	$469	$31	$2	$1.06
Urea 46N	46	2.41	10.3	4.3	74.6	AGP1	$221	$534	$62	$36	$1.58
Urea 0+46N	46	2.13	10.1	4.8	76.4	AGP1	$221	$472	$62	-$26	$0.58
Green urea 0+46N	46	2.30	10.5	5.1	72.7	AGP1	$221	$507	$67	$5	$1.07
Urea 23+23N	46	2.32	10.1	5.1	77.3	AGP1	$221	$514	$62	$16	$1.26
Urea 23+46N	69	2.42	10.9	3.9	76.4	APW1	$231	$559	$94	$29	$1.31
Urea 23+ GUrea 46N	69	2.35	11.0	4.0	75.1	APW1	$231	$544	$99	$9	$1.09
Urea 46+46N	92	2.47	11.6	3.4	76.8	H2	$239	$591	$125	$30	$1.24
Urea $624/t landed, Green urea $674,					prices Apr 2014						

Source: Incitec Pivot Fertilisers, 2017. Data collected from trials as above.

Yield and estimated net returns in wheat at Beauchamp in 2014

Fertiliser Treatment	Total N applied (kgN/ha)	Application Timing	Yield (t/ha)	Protein %	Screen%	Grade	Price ($/tonne)	Gross returns ($/ha)	N cost ($/ha)	$/ha net of N cost v control	Risk reward ratio
nil (Granulock Z 73 kg/ha)	0		2.23	8.7	2.4	ASW1	$275	$613	$0		
43 urea	20	BAS	2.70	9.3	1.3	ASW1	$275	$742	$24	$105	$5.37
43 urea	20	GS31	2.54	9.0	1.8	ASW1	$275	$699	$24	$61	$3.55
87 urea	40	BAS	2.89	10.1	1.1	ASW1	$275	$796	$48	$134	$3.80
87 urea	40	GS15	3.05	10.3	1.0	ASW1	$275	$839	$48	$178	$4.71
43 urea +43 urea	40	BAS+GS31	3.08	9.7	0.9	ASW1	$275	$846	$48	$185	$4.85
43 urea +43 urea	40	GS15+GS31	3.20	9.9	1.5	ASW1	$275	$881	$48	$220	$5.58
87 urea	40	GS31	2.71	10.0	1.2	ASW1	$275	$745	$48	$84	$2.75
43 urea +43 urea	40	BAS+GS39	2.78	11.5	0.9	H2	$291	$810	$48	$149	$4.09
130 urea	60	BAS	3.22	11.3	0.8	APW1	$283	$911	$72	$225	$4.13
43 urea +43 urea +43 urea	60	BAS+GS15+GS31	3.29	10.6	0.8	APW1	$283	$930	$72	$245	$4.40
174 urea	80	BAS	3.25	12.4	0.6	H2	$291	$946	$96	$237	$3.47
43 urea +87 urea +43 urea	80	BAS+GS15+GS31	3.44	10.7	0.5	APW1	$283	$972	$96	$263	$3.74
261 urea	120	BAS	3.04	13.2	0.9	H1	$302	$918	$144	$160	$2.11
	Grain prices delivered Quambatook (18 Dec 2014)										

Source: Incitec Pivot Fertilisers, 2017. Data collected from trials as above.

Yield and estimated net return in wheat at Nyah West in 2016

Total N applied (kgN/ha)	N cost ($/ha)	Timing	Yield (t/ha)	Wheat price del Melb	Protein %	Grade	Gross return ($/ha)	$/ha net of N	Risk reward*
0	$0	nil	2.13	$185	7.8	ASW	$394	$0	$0
20	$18	Sowing	2.69	$185	7.9	ASW	$497	$85	$3.72
40	$36	Sowing	3.06	$185	8.3	ASW	$566	$136	$2.77
40	$36	Late Tillering	3.87	$185	9.3	ASW	$716	$286	$6.94
40	$36	3rd Node	2.39	$185	8.7	ASW	$442	$12	$0.03
60	$54	Sow/Late tillering/3rd node	3.8	$185	10	ASW	$703	$255	$3.72
80	$72	Sow/Late tillering/3rd node	3.9	$185	10.2	ASW	$721	$255	$2.54
120	$108	Sow/Late tillering/3rd node	4.07	$205	11.2	APW	$834	$332	$2.07
Assumptions: $235/t APW Melb; +$20/t H2, +$30/t H1, -$20/t ASW; Melb Freight $30/t; Urea $430/t ($0.93/kgN) on farm									

Source: Incitec Pivot Fertilisers, 2017. Data collected from trials as above.

Using a basic water use efficiency (WUE) calculation for each trial year shows the value in managing nitrogen rate with respect to utilising moisture.

Water Use Efficiency in wheat, 2013, Stored 5 mm, GSR 221 mm

N applied (kg/ha)	Yield (t/ha)	kg grain/mm
0	1.97	16.9
23	2.21	19
46	2.41	20.7
69	2.42	20.8
92	2.47	21.2

Water Use Efficiency in wheat, 2014, Stored 20 mm, GSR 214 mm

N applied (kg/ha)	Yield (t/ha)	kg grain/mm
0	2.23	17.9
20	2.7	21.7
40	2.89	23.3
60	3.22	25.9
120	3.04	24.5

Water Use Efficiency in wheat, 2016, Stored 24 mm, GSR 272 mm

N applied (kg/ha)	Yield (t/ha)	kg grain/mm
0	2.13	11.4
20	2.69	14.3
40	3.06	16.3
60	3.81	20.3
80	3.91	20.8
120	4.07	21.7

Nitrogen is a key driver in maximising yield from moisture, leading to greater on farm returns.

The difficulty is the unpredictability of seasonal conditions.

Using a planned approach in adjusting yield based on moisture and seasonal outlook, setting protein targets and not being overly conservative with nitrogen rates will generally lead to favourable outcomes.

For more information, feel free to contact me on 0412 565 176 or lee.menhenett@incitecpivot.com.au.

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