Port Kenny focus site, prepared 15 April 2024

***Table 1**. Port Kenny focus paddock information.*

Crop	Sowing	Maturity	Soil type	Stored moisture (0-60 cm)	Stubble	Initial N (0-60 cm)	N applied @ seeding
Wheat	1 May	5 Nov.	Calcareous sandy loam	5 mm	Medic	58 kg/ha	20 kg/ha

The focus paddock at Port Kenny yields consistently and is very capable of reaching top end yields in better years. Figure 1, utilising Yield Prophet modelling, illustrates the potential yield outcomes across one hundred seasons, using local climate data and soil conditions. The probability spans from 0% (representing the wettest year on record) to 100% (indicating the driest year recorded), with all outcomes in between corresponding to associated rainfall levels. These outcomes can also be discussed in terms of deciles; where a decile 1 represents the lowest 10% of years, and a decile 10 represents the highest 10% of years. The blue line solely considers rainfall, while the dotted blue line factors in the detrimental effects of frost and heat on yield. The green line indicates the current yield potential based on measured initial nitrogen levels.

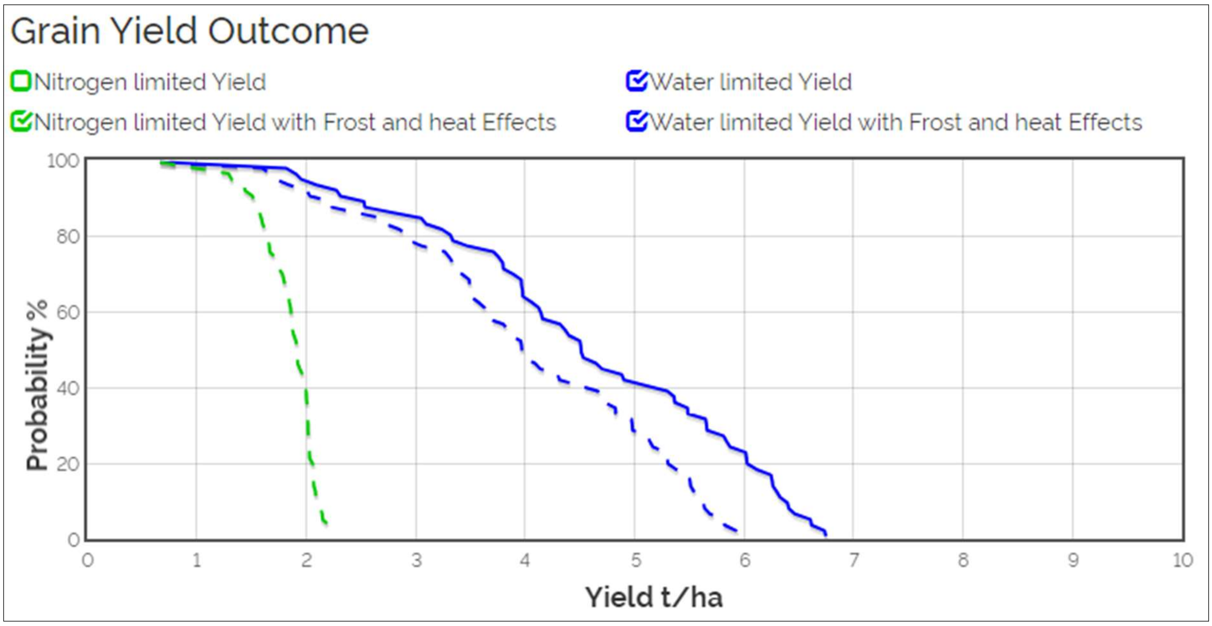

***Figure 1**: Yield Prophet graph from Port Kenny, generated on 15 April 2024. Green line indicates the predicted nitrogen limited yield and blue line indicates the water limited yield. The dotted blue line represents water limited yield potential with frost and heat effects. This is based on the assumption that yield is only limited by these factors and no others (ie pests, weeds, diseases).*

<u>What does the above tell us?</u>

1. The spread in yield potential from the lowest to highest yields is 4t/ha.
2. The nitrogen gap is large due to low starting N. It becomes larger as water limited yield potential increases.
3. Heat and frost, while they have an effect in this environment (0.5-1 t/ha), are not as important as N.

This might prompt many questions that will attempt to be addressed in the following pages. The following is designed to provoke thoughts on how to optimise an approach for considering uncertainties around deciding on the most appropriate nitrogen strategy for the upcoming season.

***Table 2**: Average net margins from varying N application decisions across deciles. Pricing based on current prices, April 2024 (urea $800/t + $10 application, wheat $320/t).*

Port Kenny 15th April 2024				Urea applied (kg/ha)					
Decile	WLY	NLY	Yield gap	0	45	90	135	180	270
				Net margin ($/ha)					
Decile 1	1.7	1.3	0.4	416	499	454	409	364	274
Decile 2	2.6	1.6	1.0	512	627	742	697	652	562
Decile 3	3.3	1.7	1.6	544	659	774	889	876	786
Decile 4	3.5	1.8	1.7	576	691	806	921	940	850
Decile 5	3.8	1.9	1.9	608	723	838	953	1036	946
Decile 6	4.1	1.9	2.2	608	723	838	953	1068	1042
Decile 7	4.8	2	2.8	640	755	870	985	1100	1266
Decile 8	5.2	2	3.2	640	755	870	985	1100	1330
Decile 9	5.5	2.1	3.4	672	787	902	1017	1132	1362
Decile 10	5.8	2.2	3.6	704	819	934	1049	1164	1394
Average net margin ($/ha)				592	704	803	886	943	935

WLY = water limited yield, NLY = nitrogen limited yield

Table 2 shows the $ response to a range of seasonal rainfall outcomes and corresponding nitrogen decisions. These numbers are based on a range of measurements, evidence-based assumptions, and modelled predictions. While they may appear complex at first, each monetary figure represents the result of a specific decision could be made in a particular season. By averaging these figures across seasons, the grower can identify where the best return on inputs can be achieved over the long term, considering all potential seasons.

Applying these principles, the most profitable path over the long-term can become much clearer, avoiding biases developed by what has occurred in recent years and other factors that can influence decision making.

'Getting it between the sticks'

While this approach can appear a little complex, it can help to form some valuable insights to decision making, that can't be achieved through gut feel but leaving plenty of flexibility for differing attitudes to risk. It can help a grower understand their current position, and the path to "get it between the sticks". What can more beneficial is the recognition that there's no one-size-fits-all solution and optimal decisions can be achieved over a number of seasonal outcomes. For instance, in the example below (Figure 2), best return from applying nitrogen is maximised with a return at around $940/ha, the amount of nitrogen needed to achieve ranges from 160-220 kg/ha of urea (a gap of 60 kg/ha of urea), demonstrating that there is a lot of scope for personal preference in the decision-making process, even with the full spectrum of seasonal outcomes being considered.

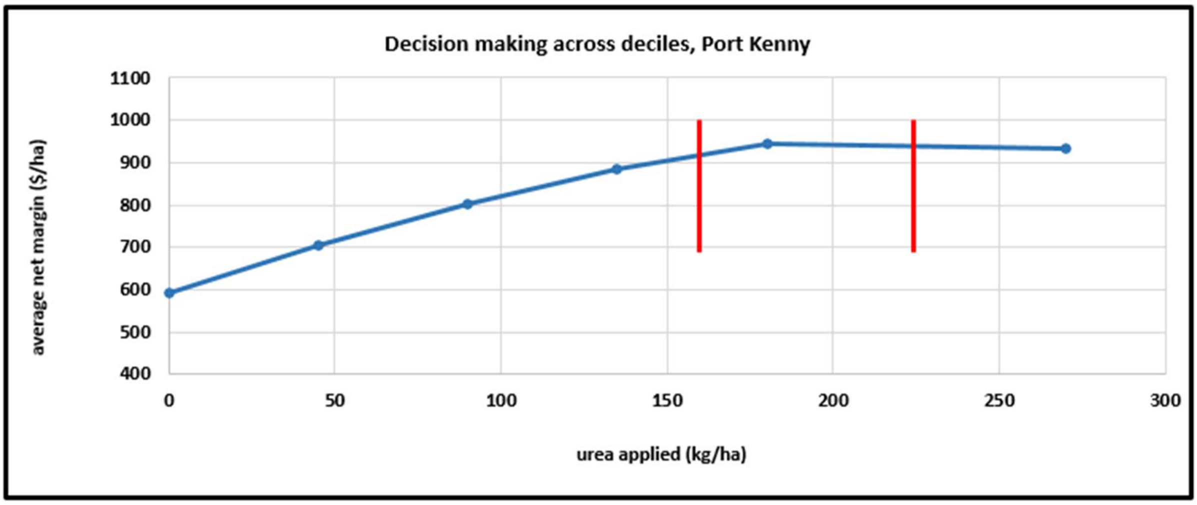

Figure 2. *Average net margins ($/ha) across 10 deciles and 4 different nitrogen application rates.*

What's the next step? There are two clear options. The straightforward answer derived from this graph is that 180kg/ha urea is the optimal amount, as it yields the highest return over time.

Another consideration is that urea is costly and using 180kg/ha compared to 135kg/ha may result in losses in 3 out of 10 years. For a 2000ha cereal program, this could potentially cost the grower $90,000. However, the long-term gain averages approximately $57/ha annually (with 7 out of 10 years realizing greater margins than the application of 135kg/ha). This amounts to a yearly benefit of $114,000 for a 2,000-hectare program on average. While the numbers suggest a sound long-term approach, it comes with inherent risks, as with any input. The business must be prepared to absorb potential losses in poor years to realise the long-term gain.

A calculated approach doesn't come without its complexities, and a reasonable time and effort requirement, but it can help demonstrate how looking at a range of outcomes can better inform difficult decisions.

To conclude here are some points to consider. How well do you understand the following for a range of soil types and paddock histories across your property?

1. Initial soil nitrogen levels.
2. The response achieved from applying nitrogen (rules of thumb such as 40kg/ha N is required to achieve 1t/ha yield gain – when N is limiting, are often used. But some soils on EP don't respond this way).
3. Available soil moisture.
4. The impact of frost and heat. Both can have a huge impact on grain yields in the EP environment, but it's important not to over-estimate the effect they can have.
5. Have you allowed for the carry-over of N fertiliser? Increasingly we are improving our knowledge of how un-used nitrogen can be carried over from one season to the next, so over-fertilisation can be utilised by following crops, and not a loss to the business.

Well above average rainfall in December and early January, across many parts of the Eyre Peninsula, coupled with a solid summer weed control program has resulted in high levels of stored soil moisture, but there is considerable variation in the soil moisture measurements collected as part of this project, so assuming high stored plant available water levels may be fraught with danger. Also, there has been large variation in soil nitrogen levels observed across

EP. Paddocks where crops such as lentils were grown in 2023 have shown mediocre soil N levels in some, but not in all cases.

These factors can sway the outcome of your decision, so it's important to give them some thought. While deep nitrogen testing and soil moisture probes can provide the most accurate data, making an informed estimate, where a range of outcomes are considered is preferable to guesswork.

We aim to regularly update the information provided in this paper for the Port Kenny focus paddock, to help track how nitrogen applications respond to seasonal conditions and yield forecasts.

If you require any further information or would like to discuss the way you are approaching nitrogen decisions for the upcoming season, please contact Jacob Giles, EPAG Research, Port Lincoln on 0431 110 018 or jacob@epagresearch.com.au.

All the best for a fantastic opening to the season and a smooth seeding.

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