

Nitrogen economics update

In light of recent jumps in fertiliser price and uncertain supply as a result of conflict in the Middle East, it's important to reassess nitrogen strategy. Whether you've already secured a comfortable amount of urea for your program, or were waiting out to get more for later topdress applications, running the numbers on economic return from applying nitrogen can help guide where to prioritise fertiliser applications. Take stock of your current situation based on the quantity of urea that you have locked in before making reactive decisions.

NITROGEN RESPONSE CURVE

The economic return of urea is based on the interaction between urea price and grain price (see Figure 1). It is helpful to frame the value of urea as the return in income you receive as a result of investment in urea, which can be shown as a Benefit:Cost ratio. This ratio shows the financial return for every dollar spent. For example, a Benefit:Cost ratio of 3 shows that for every \$1 spent on urea, the gain in grain income as a result of increased yield is \$3. It is important to note that this model assumes that the crop is nitrogen responsive.

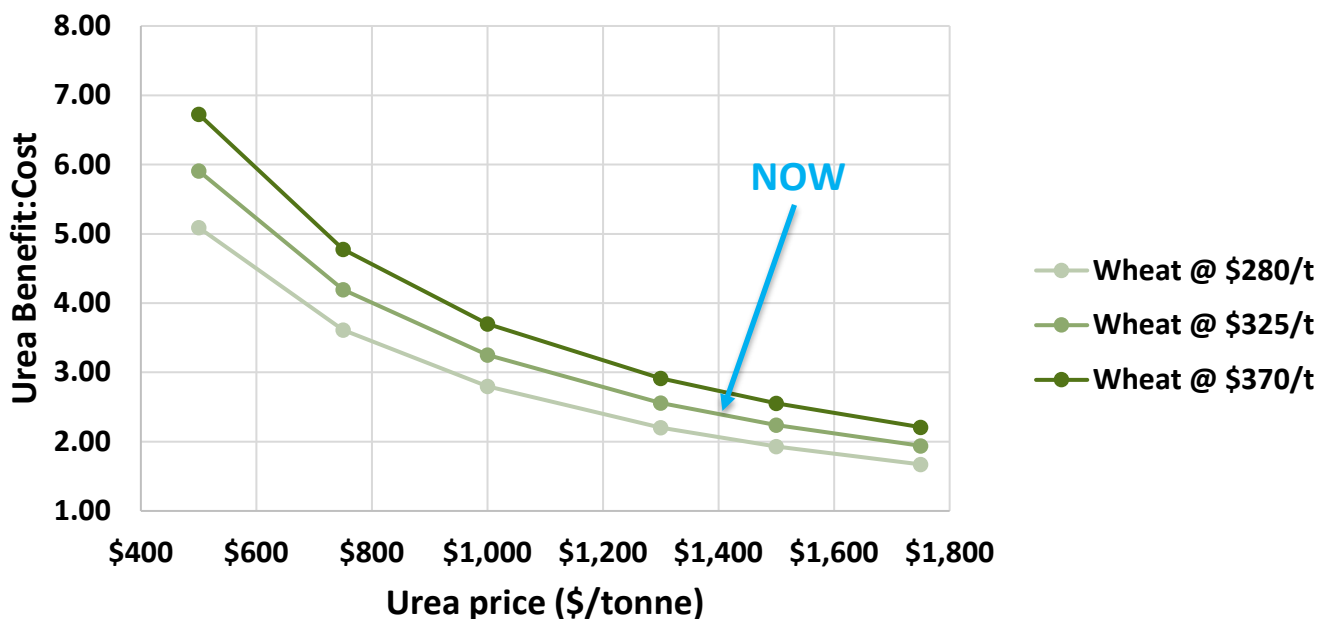


Figure 1. Nitrogen response curve for urea and wheat at different prices, to show the return on investment.

As urea price increases, the Benefit:Cost ratio decreases as there is less net financial gain from fertiliser application as it costs more with no additional income gained. This is the situation that we're observing now. However, it should still be noted that the Benefit:Cost ratio can still be positive, just not as strong as it was previously with lower urea prices.

The other factor to consider is grain prices. As grain price decreases, the Benefit:Cost ratio also decreases as the investment in urea generates less grain income for the same cost. Unfortunately, when high urea prices are coupled with low grain prices, the return on investment is lower. The current Benefit:Cost ratio for wheat at a price of \$325/t (on farm) and urea at roughly \$1400/t is \$2.60 return for every \$1 spent on urea. Even if urea is secured at higher prices, it is still profitable when applied to responsive crops.

PRIORITISING CROP TYPES

With potentially tight supply, it may be wise to prioritise crops that generate the best return on investment (ROI) of urea. The difference in economic return is based on different grain prices and nitrogen requirements. Table 1 summarises the factors that influence the ROI of crop types, at a set urea price of \$1400/t. It takes into consideration the rate of urea required to increase yield by 1t/ha and price for a tonne of grain to determine the net benefit. Again, this assumes a responsive crop.

Table 1. Economic return of investment in urea for different crop types, using approximate prices. Based on a urea price of \$1400/t and a spreading cost of \$10/ha.

	Canola	GM Canola	Wheat (APW)	Barley (BAR1)	Durum (DR1)	Cereal Hay
<i>Crop N requirement per 1t/ha grain/hay (kg N/ha)</i>	80	80	40	35	50	15
Urea rate to increase yield by 1t/ha	175kg/ha	175kg/ha	90kg/ha	76kg/ha	108kg/ha	32kg/ha
Grain/hay price (\$/t)	\$750	\$680	\$325	\$300	\$475	\$200
Return per \$1 spent on urea (i.e. Benefit:Cost ratio)	\$3.10	\$2.80	\$2.60	\$2.80	\$3.10	\$3.70

It is important to remember that making decisions to favour cashflow aren't necessarily going to favour profitability. Although canola requires a greater initial investment in nitrogen, it actually has one of the best return per dollar spent on urea, as seen above. If you can manage your cashflow, it is beneficial at this stage to keep canola in the program. The main factor favouring canola is that the price is comparatively better than wheat and barley, even when considering yield differences.

In recent years, wheat has been a higher priority to receive urea than barley as it had a better return. However, now that the wheat price has weakened, the barley economics stack up more favourably. This information is based on the current situation and can quickly change, so it may be beneficial to minimise risk by diversifying your crop types.

PRODUCT CHOICE

If urea becomes hard to source, it is an option to use other nitrogen sources such as SOA or UAN. These products have their own considerations, with SOA attracting greater freight costs as more product is needed but it does provide sulphur, and UAN may cause leaf burn and can be corrosive. SOA is most easily substitutable for urea. The price of these products follows similar trends to urea, however slight differences per unit of N which can add up quickly.

Table 2. Cost comparison of urea, UAN and SOA per unit of nitrogen. Not accounting for additional freight costs required for SOA or sulphur benefit.

Units of N (kg N/ha)	Urea (kg/ha)	UAN (L/ha)	SOA (kg/ha)
	46% N	42% N	21% N
18.4	40	44	88
27.6	60	66	131
36.8	80	88	175
46	100	110	219

Current price	\$1400 / T	\$1.50/L (\$1140 / T)	\$700 / T
\$/kg N	\$3.04	\$3.57	\$3.33
Cost for 100kg/ha urea equivalent	\$140/ha	\$165/ha	\$153/ha

The gap between urea, UAN and SOA has narrowed substantially compared to historic levels, meaning that all products could be a viable option pending supply. Note that the example above is to provide an approach – prices are changing very rapidly and you will need to do your own numbers! And there is a benefit from the sulphur in SOA that is useful if your paddocks and crops are sulphur responsive, which isn't accounted for above.

WHAT AM I FED TO?

Before rushing to make decisions, it is best to figure out what your current 'fed-to' yields are based on the quantity of urea that you have guaranteed. The results can confirm the actual urgency of securing urea based on target yields. Based on the crop's response curve, not all nitrogen applications are profitable, especially at these high prices, even if it generates an increase in grain yield and income. This is because the benefit doesn't outweigh the cost of fertiliser. The most profitable nitrogen is the first few units that are supplied, so it is best to ensure everything has at least some nitrogen applied (e.g. 1st topdress). It may not be worthwhile getting caught up at this stage on subsequent nitrogen applications, as they may not even be profitable at these urea prices.

To determine total estimated nitrogen supply, the first step is to quantify the amount of starting nitrogen in the soil. This is usually indicated by a deep nitrogen sample taken from a 0-60cm soil core, but can also be estimated. Conservative deep N results for budgeting could be 40kg/ha for cereals/canola and 60kg/ha for legumes, but adjust these numbers based on crop removal, applied fertiliser from last season and potential N fixation for legumes. Hopefully, with recent soil moisture, there is some mineralisation and this year's results will be higher than expected.

Secondly, add up the nitrogen (kg N/ha) that you intend to supply to the crop from fertiliser, based on secured quantities. This includes nitrogen from sowing fertiliser, any pre-spread fertiliser (e.g. SOA) or manure application, and potential topdress applications. If you have low stocks of urea, prioritise crop types based on the table above.

The last consideration for total nitrogen supply is mineralisation as the year goes on. Typically, we don't rely on the 'free kick' of nitrogen mineralisation in spring as this risks mining the system of nitrogen and organic matter. However, in years with tight supply and high prices, it is more tempting to take advantage of the 'free kick', assuming that we don't do this every year. Mineralised nitrogen is difficult to quantify as it depends on soil characteristics and environmental conditions, but rough assumptions for a loam soil with organic carbon >1.2% are as follows:

- Legume stubble: 15-40kg N/ha
- Canola stubble: 10-20kg N/ha
- Cereal stubble: 0kg N/ha

Once you have calculated total estimated nitrogen supply, you can proceed with the equations below to determine fed-to yield and additional nitrogen requirements to meet target yield.

$$\text{STEP 1: Fed-to yield (t/ha)} = \frac{\text{total estimated nitrogen supply}^{\wedge} \text{ (kg N/ha)}}{\text{crop N requirement per 1 tonne}^* \text{ (kg N/ha)}} \quad \wedge(\text{total N supply} = \text{deep N result} + \text{N fertiliser applied} + \text{mineralisation})$$

$$\text{STEP 2: Additional N required (kg N/ha)} = (\text{target yield} - \text{fed-to yield}) \times \text{crop N requirement per 1 tonne}^*$$

*Crop N requirement to increase grain yield by 1t/ha:

- Wheat @ 11% protein, 40kg N/ha or 90kg/ha urea
- Barley @ 10% protein, 35kg N/ha or 76kg/ha urea
- Durum @ 13.5% protein, 50kg N/ha or 110kg/ha urea
- Canola @ 42% oil, 80kg N/ha or 175kg/ha urea

Note: this assumes a 50% uptake efficiency of the total nitrogen supply (soil and fertiliser), the crop is responsive to additional nitrogen and soil moisture levels are not limiting yield.