Nitrogen requirement for Northern Region winter cereals 2021

Growers who were able to complete their winter crop planting program in 2021 are now enjoying regular rainfall events to solidify their crop yield prospects. In fact, the complete turnaround in fortunes may now even be increasing crop yield potentials, with implications for nitrogen management.

It is timely for us to revisit in-crop nitrogen strategies for the northern grains region, given that many growers and agronomists are perhaps out of practice with topdressing after the seasons we've seen recently. The 5Rs of nutrient stewardship are a good starting point when making nitrogen decisions.

Right Agronomy

Many growers started the season with soil profiles that were high in nitrogen, largely due to the drought, low yielding crops and low cropping frequencies in recent seasons. Others have double cropped cereals into recently harvested summer crop ground, with mixed nitrogen strategies being employed.

It is now worth considering the fate and/or position of existing soil nitrogen and what may have changed since the last soil test. If paddocks are sitting on a higher yield potential than pre-plant nitrogen budgets accounted for, some recalibration of the nitrogen program will be required.

Right rate

The appropriate rate of additional nitrogen can only be determined if the existing soil nitrogen levels are known. If paddocks are trafficable, in-crop deep N testing in winter cereals is an accepted method to accurately ascertain the quantity and position of ammonium and nitrate nitrogen. Segmented profile sampling can also be used to check sulphate sulphur, chloride and EC levels.

Use sample depths of 0-10 cm, 10-30 cm, 30-60 cm and 60-90 cm if constraints are unknown. If there are no subsoil constraints, use sample depths of 0-10cm, 10-30 cm, 30-90 cm or 0-10 cm and 10-90 cm. Subsoil sampling is quite important. This is where most of the nitrogen was in the soil tests we reviewed from the northern grains region prior to the start of the season. Plenty of subsoil moisture, co-located with a known nitrogen supply, may mean that no further action is required.

Other useful tools to derive the right rate may include previous soil test data, nitrogen budgets, previous grain test results and other industry tools like NBudget or Yield Prophet. These tools can help growers and agronomists model any upsides to yield potential and determine appropriate additional nitrogen rates to achieve the new targeted yields.

Table 1: Nitrogen supply (kg/ha) required to achieve wheat yield and grain protein

Yield (t/ha)	Grain protein (%):							
	7	8	9	10	11	12	13	14
1.0	25	28	32	35	39	42	46	49
1.5	37	42	47	53	58	63	68	74
2.0	49	56	63	70	77	84	91	98
2.5	61	70	79	88	96	105	114	123
3.0	74	84	95	103	116	126	137	147
3.5	86	98	110	121	135	147	159	172
4.0	98	112	126	140	154	168	182	196
4.5	110	126	142	158	173	189	205	221
5.0	123	140	158	176	193	210	228	245

Source: Incitec Pivot Fertilisers

Right place, time and product

Northern Grower Alliance (Daniel et al, 2019) has shown over recent years that the movement of nitrate down the profile is slow. This means that applying nitrogen as a topdress earlier is generally better than later to ensure that ample nitrogen is present in the root zone when it is needed.

Fertiliser should only be applied to aerated soils, with an active aerated root zone for the nitrogen to move into. For root uptake of nitrogen and water to occur, the crop roots need to be active close to the surface or in the shallow subsoil.

Applying nitrogen to wet and waterlogged soils is likely to lead to nitrogen losses through direct water movement and runoff, or in denitrification losses. Crop nitrogen and water uptake is limited in these conditions anyway. Keep your hands in your pockets and your keys out of the tractor until drier soil conditions return and the crop starts to actively grow again!

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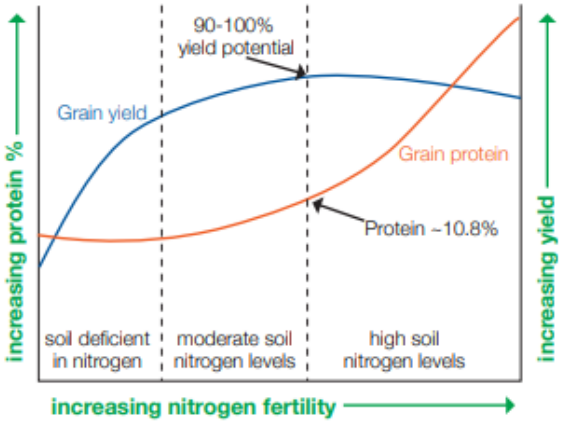
Along with urea broadcasting using spreaders, urea can be mid-row banded if necessary. Foliar application of urea ammonium nitrate (UAN) products like EASY N® can also be used during periods of active growth. EASY N can also be applied direct to the soil using streaming nozzles at higher rates for a quick and efficient nitrogen application with minimal labour.

Crop safety is largely good when EASY N is used, where appropriate nozzles are selected for the application conditions (temperature and crop stage). Take care with foliar applications of EASY N in warmer spring conditions. Consider the plant part target when considering tank mixes and always consult the label and tank mix partner manufacturers advice for crop safety and compatibility data.

Applications of nitrogen from tillering through to the start of stem elongation (GS21-31) impact yield and can lead to a dilution in grain protein concentration as yield increases. See Figure 1. Applications from flag leaf emergence (GS39) onwards heavily impact grain protein. Protein responses to the application of nitrogen from GS39 to GS60 are more reliable when yield is already maximised and seasonal conditions are above average. Aim to maximise yield potential first and only then consider later incremental applications of nitrogen if market demand for protein warrants the additional nitrogen investment beyond maximising grain yield.

Figure 1: Effect of increasing nitrogen on yield and protein



Source: GRDC Grow Notes, Wheat, February 2016

Nitrogen losses in northern grain systems

According to research by Schwenke et al (2014) ammonia volatilisation losses from granular urea applied in-crop to wheat in the northern growing region are between 3.1% and 7.6% of the nitrogen applied (average of 4.8%). Volatilisation is influenced by soil temperature, wind, follow-up rainfall and nitrogen rate, but in the cooler months, the magnitude of potential losses is quite low. The safest applications are those made to dry clay soils, in non-humid conditions with no wind and sufficient rainfall to move the urea into the soil within a few days of the application.

Later in the season, broadcast urea could be prone to much greater volatilisation losses due to warming soil and ambient temperatures, especially if ample rainfall is not received to incorporate the nitrogen within 24 to 36 hours of application. Schwenke notes total losses of <15% of applied nitrogen in winter crop systems from volatilisation.

Products like Green Urea NV™, with a urease inhibitor, are worth considering in situations such as later season applications where spring temperatures and rainfall are difficult to predict. Green Urea NV delays the process of hydrolysis on the soil surface, giving growers more time to receive ample incorporating rainfall or irrigation for up to 10 to 14 days after broadcasting.

Unfortunately, nitrate nitrogen can also be prone to losses from denitrification. Denitrification (gaseous loss) is a more significant loss pathway for northern systems, where >30% of applied nitrogen has been shown to be lost in some studies (GRDC 2016).

If wet anaerobic conditions and waterlogging events persist, some losses as nitric oxide (NO), di-nitrogen (N2) or nitrous oxide (N20) may be experienced in spring as soil temperatures warm up. This is also when crop nitrogen demand is at its highest, and any losses can have large yield and protein implications later in the season. While soil temperatures are low in the winter months, some losses can still occur, albeit of a small magnitude.

For pre-plant banding and drilled application methods, ENTEC® urea, an ammonium stabiliser, can be useful to reduce leaching and denitrification losses. This product is not recommended for either surface broadcasting applications or in-crop timings, and should not be applied broadcast directly to the soil surface. ENTEC urea slows the oxidation of ammonium into nitrite then nitrate by bacteriostatically slowing the soil bacteria (nitrosomonas spp.) responsible for that process. The result is that nitrogen is always available to crops as positively charged ammonium nitrogen, but will not move through the soil to be lost via leaching, as it is adsorbed and bound to clay colloids.

Ammonium stabilisers only act on the fertiliser nitrogen they are in contact with, thus are unable to inhibit or retain nitrogen already in the nitrate form (like much of the long fallow profile nitrogen we started this season with). Years where episodic spring wet and waterlogging events have occurred in the northern growing region include 1998, 2004, 2011, 2012 and 2017.

Be mindful of your strategy, how fortunes have changed, and flexibly adapt your in-season response to suit. Best wishes for a bumper 2021 winter crop harvest!

References

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