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Insights from IPF maize trials: Keeping nitrogen where it belongs with enhanced efficiency fertilisers

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Summer cropping presents the perfect storm for nitrogen losses. Warm temperatures, frequent irrigation, and high fertiliser rates combine to accelerate denitrification and volatilisation of urea, leaving less nitrogen available for crops when they need it most.

Incitec Pivot Fertilisers' (IPF) Smart Nitrogen range of enhanced efficiency fertilisers (EEFs) reduce these losses. A comprehensive 2025 trial in irrigated maize at Nathalia in Victoria's Goulburn Valley demonstrated the efficacy, and economic benefit, of protecting nitrogen with eNpower® and Green Urea NV®.

When high rates of urea are banded at sowing, eNpower reduces losses from leaching and denitrification. By holding nitrogen in the ammonium form, applied nitrogen stays in the soil becoming available to crops as they mature. When top dressing urea, Green Urea NV is effective in reducing losses through ammonia volatilisation.

Preventing losses of nitrogen from the system improves fertiliser use efficiency, increases production potential and boosts the bottom line.

The nitrogen cycle and EEFs

Nitrogen fertilisers are dynamic and undergo several transformations when applied to the soil. Ultimately, the form of nitrogen will dictate the potential loss pathways it is exposed to. Figure 1 demonstrates these transformations in soil, and where the EEF products have the

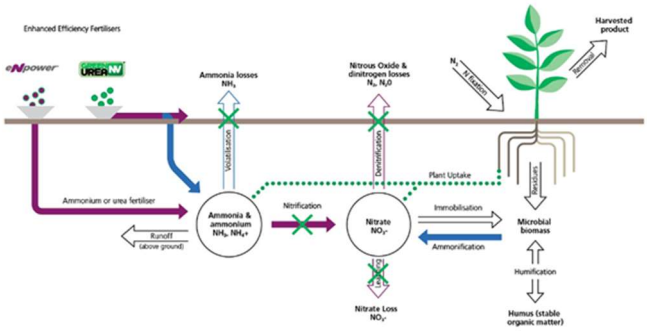

Figure 1: Activity of EEFs on the nitrogen cycle. Source: Incitec Pivot Fertilisers.

Denitrification – why you should care

Denitrification, favoured by warm, wet conditions and supercharged by high rates of nitrogen can become a significant cost to a farming operation. Figures 2 demonstrates the cumulative losses of nitrous oxide (N2O) in irrigated maize.

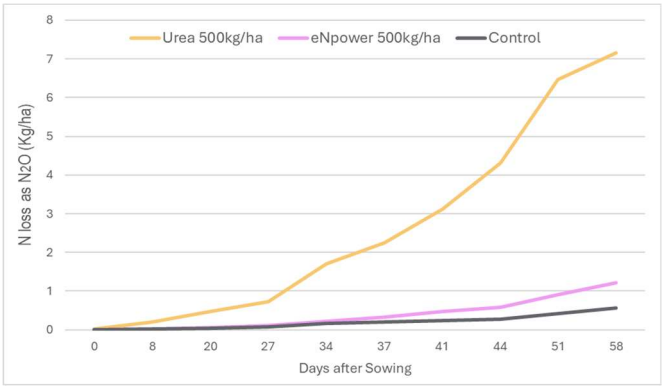

Figure 2: Cumulative nitrous oxide emissions in irrigated maize. Source: Incitec Pivot Fertilisers 2025.

Whilst significant from a greenhouse gas perspective, losses of nitrogen as nitrous oxide represent only a small part of the total denitrification loss. The end product, dinitrogen gas (N2), often outstrips these emissions by factors of up to 40+:1 (Bell M, 2013-14). Alkaline clay soils represent the highest risk.

Figure 3 quantifies the ratio of nitrous oxide to dinitrogen gas under different waterlogging conditions. At 100% water filled pore space (WFPS), or total waterlogging, a greater proportion of N2 is evolved per unit of N2O. This is contrasted with the graph on the right, which shows that as WFPS falls, so too does the ratio of N2:N2O. Water dynamics in the soil will change over a growing season, with rainfall, irrigation and evaporation-transpiration all playing a role. For practical purposes, an average ratio of between 1:5 – 1:10 can be assumed, taking into account periods of higher and lower WFPS across a growing season.

In practical terms, this ratio indicates that for 1kg/ha of nitrogen lost as nitrous oxide, 5-10kg/ha has additionally been lost as dinitrogen gas. As such, the total denitrification loss is much higher than what can be measured in the field.

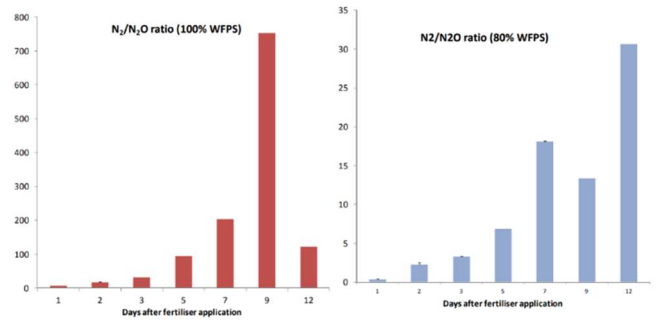

Figure 3: Dinitrogen (N2) to nitrous oxide (N2O) ratio under waterlogged conditions.

Source: Scheer et al, 2014 (unpublished).

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Where does eNpower® fit in?

eNpower is a stable nitrification inhibitor, providing up to 12 weeks protection for applied nitrogen. IPF trials have determined the efficacy of the product, measuring an 84% reduction in nitrous oxide emissions over 58 days in the 2025 maize trial in Nathalia, Victoria.

As part of this trial, 500 kg/ha of urea (230kg/ha of N) was strip tilled prior to planting, with emissions from the band measured weekly after planting. Figure 4 shows the efficacy of eNpower in the two randomised blocks that were sampled, with effective reduction of denitrification measured in both.

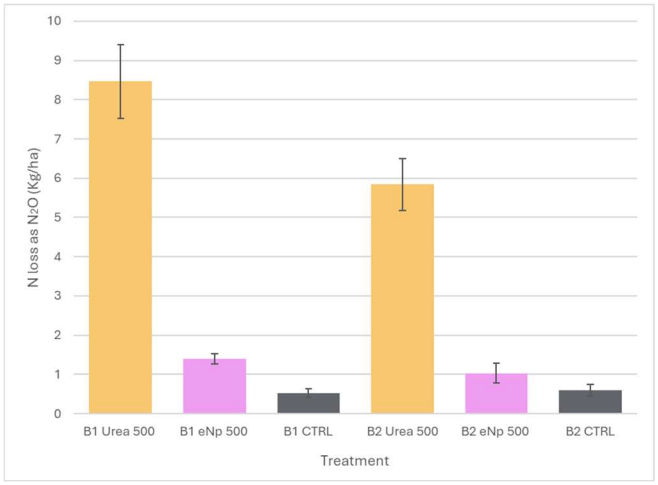

Figure 4: Total nitrous oxide loss (kg N/ha) over 58 days and the reduction with the use of eNpower®. Source: Incitec Pivot Fertilisers 2025.

What about volatilisation?

Urea broadcast on the soil surface rapidly hydrolyses, potentially forming volatile ammonia gas. The catalyst of this process in the naturally occurring urease enzyme. Warmer temperatures, moist drying soils, higher soil pH are some of the factors that increase the potential for gaseous losses.

Ammonia losses will begin within a day of application and can last for more than 14 days. With moisture present to start the hydrolysis process, generally >65% of total losses will occur in the first seven days and the remaining losses over the next seven days. Physically incorporating broadcast urea or receiving >10mm of rainfall/irrigation is required to lock the urea deep enough into the soil to minimise losses.

Irrigation in summer cropping allows control over water rate and timing, which potentially removes any volatilisation concerns, however where timely incorporation of urea isn't practical, Green Urea NV is an effective way to reduce nitrogen loss as volatilisation.

These losses were also investigated at the Nathalia site where 250 kg/ha of urea (115kg/ha of nitrogen) was applied via top-dress. The cumulative losses over seven days are demonstrated in Figure 5.

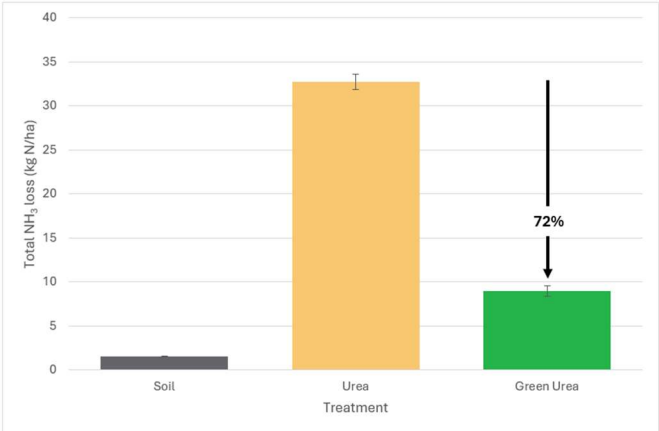

Figure 5: Total ammonia (NH3) loss (kg N/ha) over seven days and the reduction of volatilisation with Green Urea NV®. Source: Incitec Pivot Fertilisers 2025.

How does this affect my bottom line?

By protecting the nitrogen investment with eNpower, growers save both the direct cost of nitrogen lost to the system, as well as enjoying the benefit of extra yield from that nitrogen being available to the crop.

With nitrogen prices elevated, direct losses of nitrogen to the atmosphere alone are sufficient to warrant investment in EEFs.

Figure 6 demonstrates the cost of a denitrification loss profile on pre-plant urea. The modelling assumes a urea price of $850/t (1.85/kg of nitrogen). Assuming an average N2:N2O ratio of 1:10, total losses of applied nitrogen from an initial application of 230 kg N/ha sit at almost 80kg. This represents a cost of over $140/ha, without considering the implications for production.

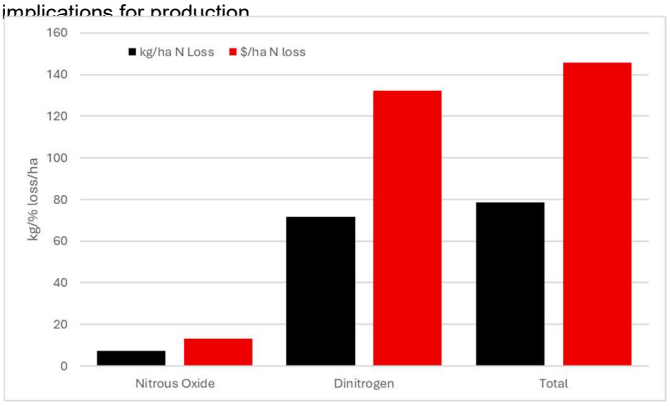

Figure 6: Cost of denitrification – direct cost of lost nitrogen (N2:N2O ratio 1:10). Source: Incitec Pivot Fertilisers 2025.

Likewise, Figure 7 investigates the cost/benefit ratio of investing in Green Urea NV. Again, assuming a urea price of $850/t, by quantifying the daily loss profile of ammonia volatilisation, it is possible to determine the point at which benefits offset the initial

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investment in Green Urea NV. In this trial, over 30kg/ha of nitrogen was lost as ammonia, with close to 10kg/ha lost by day two.

Accounting for the additional cost of Green Urea NV ($53/t or $13.25/ha at 250kg/ha), the investment in protecting the applied urea pays for itself in volatilisation reduction after two days. At this point, 9.3kg/ha of nitrogen has already been lost from the uncoated urea, equating to a dollar value $17/ha.

Remember that even when irrigating, if a pivot or lateral cannot get across the whole paddock within two days, or if urea is to be spread over a large area and then followed with water, potential for losses becomes significant.

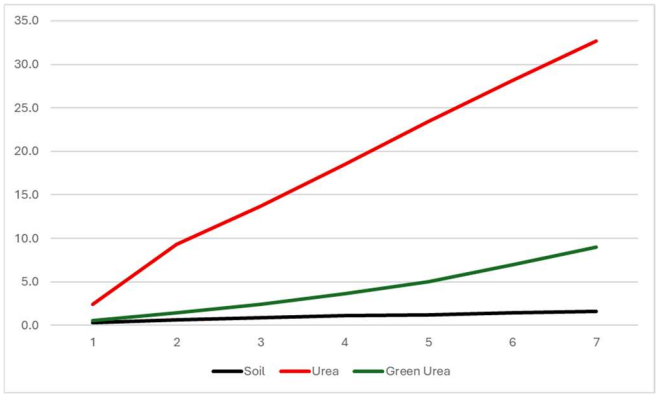

Figure 6: Cost of volatilisation – cumulative loss of ammonia. Source: Incitec Pivot Fertilisers 2025.

How does this affect my bottom line?

Summer cropping is a high-risk situation for nitrogen loss. High rates of nitrogen fertiliser, either banded or top dressed, increase the risks of losses through denitrification and volatilisation. Understanding the loss pathways applicable to a nitrogen application will assist in selecting the right EEF to assist in reducing these losses.

The value of lost nitrogen can be quantified not only by the direct emissions of nitrogen, but also as a loss from the system, meaning crops are unable to convert applied nitrogen to growth and therefore yield. Investing in eNpower and Green Urea is an insurance policy for your nitrogen. Both products are proven through trial work to reduce losses, keeping fertiliser where it belongs.

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Further Information

For more information about enhanced efficiency fertilisers and nitrogen considerations for summer cropping, contact IPF technical agronomists.

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