Target word count 600 to 630

Title: Highly productive crops can be more greenhouse gas efficient

Precede: By optimising nitrogen efficiency, it is possible to improve financial returns and reduce greenhouse gas emissions per tonne of grain produced

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Key points

* Nitrogen losses account for the largest greenhouse gas emissions in the grains industry
* This represents both a financial and environmental cost
* Fertiliser application practices that improve nitrogen use efficiency have the potential to increase yield and reduce emissions per tonne produced

Nitrogen fertiliser is under the spotlight as the largest source of greenhouse gas emissions in the grains industry. But the imperative to reduce nitrogen fertiliser losses is not just about reducing greenhouse gases, it is also about protecting the bottom line. Fertiliser is simply too expensive to waste.

Greenhouse gas emissions are generated via both the on-farm application and off-farm in the manufacturing and energy sector. Emissions associated with nitrogen fertilizers account for around 38 per cent of emissions in the grains industry. On farm losses – particularly losses of nitrous oxide (N2O) – contribute 15 per cent of emissions which could potentially be reduced by improving nitrogen management practices.

Using less fertiliser is not the solution. Reducing fertiliser rates reduces yield, mines nitrogen and carbon and reduces the ability of the soil to buffer emissions.

## Tackling emissions

To evaluate the potential to reduce greenhouse gas emissions from the grains sector, GRDC invested in modelling analysis across every subregion of Australia. The work was led by CSIRO Agriculture and Food in partnership with the NSW Department of Primary Industries.

The analysis found that by improving the efficiency of nitrogen use, growers stand to increase yields and generate a 10 per cent reduction in the intensity of total emissions.

Yield, nitrogen losses and soil carbon processes were analysed using the APSIM model in locally relevant cropping sequences over a 30-year period – 1990 to 2019. Modelling allowed the exploration of the impact of different nitrogen management strategies across a broad range of environments and seasonal conditions.

The current best management practice of split application – dependent on seasonal outlook and soil moisture – was compared with a *perfect* (but not currently possible) scenario where nitrogen was continually topped up through to flowering. Application rates were based on a 2005 baseline average of 38 kilograms of nitrogen per hectare or 2015 rates of 58 kg N/ha.

The results clearly showed that, across Australia, what is better for the bottom line is better for the environment.

## Yield is critical

As expected, increased rates of nitrogen fertiliser led to increased greenhouse gas emissions per hectare (Figure 1A), but grain production increased at a greater rate. Emissions per hectare increased, but the intensity – or emissions per tonne of grain production – decreased (see Figure 1B).

This reduction in greenhouse gas emissions is driven by carbon. Yes – increasing the rate of nitrogen led to higher nitrous oxide emissions, but by generating more crop biomass this could be offset by lower soil carbon emissions and in some cases by carbon fixation.

For instance, while increasing the nitrogen rate from the 2005 baseline to a best-practice strategy increased nitrous oxide emissions (Figure 1A, light green), soil carbon loss was reversed (dark green).

Although the results were highly variable depending on seasonal conditions, the trend was consistent over a 30-year period albeit with some regional differences.

Different rotations were explored in the analysis, however further work is required to understand the impact of nitrogen-fixing legume crops and pastures or green manures on emissions.

However, one thing is clear – to maintain a productive grains industry and feed the world – it is vital to achieve yield gains in the seasons where it is possible, as efficiently as possible.

GRDC research code – Justin Crosby to supply?

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<https://grdc.com.au/about/our-industry/greenhouse-gas-emissions>