

# Carbon Farming in WA

Fact sheet No. 9

## PRACTICE: **Nitrous oxide emissions from agricultural soils**

### Description of practice

Research investigating ways to lower nitrous oxide emissions from farming systems has focused largely on the use of nitrification inhibitors. Inhibitors will stop or slow down the conversion of ammonium to nitrate and reduce the chances for N losses. They can also split nitrogen applications (to better match soil nitrogen supply with plant demand), substitute legume nitrogen for inorganic fertiliser nitrogen and replace conventional cultivation with minimum tillage.

The amount of nitrous oxide released from agricultural soil is a function of:

- the amount of carbon (energy) available for soil microbes to convert soil nitrogen
- the amount of soil moisture available (more moisture leads to more nitrous oxide)
- the amount of nitrogen added to the soil via fertilisers, manure and urine.

Under the Emissions Reduction Fund (ERF), farmers can earn carbon credits by sequestering carbon or by lowering emissions of the greenhouse gases methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O). Agriculture generates 75 per cent of Australia's nitrous oxide emissions (a greenhouse gas with 300 times the global warming potential of carbon dioxide). Of the total amount of nitrous oxide emitted from agricultural soils each year, about a third is generated when microbes convert soil nitrogen into nitrate (nitrification) and nitrogen gas (denitrification).

Nitrous oxide emissions from Australian cropping systems vary widely from 0.3 kg N/ha/year in low rainfall areas, such as the coarse sand cropping systems in Western Australia; to 35 kg N/ha/year in high rainfall cropping systems on acid soils in Victoria.

Using nitrification and urease inhibitors and altering livestock diets to reduce urea production would likely qualify as 'additional' under the ERF as these methods are not currently widespread.

### Outline of procedure

If procedures are developed to enable farmers to earn carbon credits by lowering nitrous oxide emissions, they are likely to involve the use of nitrification and urease inhibitors. They may also include changes to

The Department of Agriculture and Food is the lead agency and is working with the Department of Regional Development and Lands to deliver this Royalties for Regions funded project.

For more information please refer to [agric.wa.gov.au](http://agric.wa.gov.au)

### More Information

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fertiliser management practices (split applications, use of slow release fertilisers), stocking rate and grazing management, diet formulation and feeding systems. However, there are currently no official methodologies under the ERF to support these abatement measures.

### Work done to date

Most of the nitrous oxide research so far has been carried out under the auspices of a national research program known as the Nitrous Oxide Research Program (NORP). This research focused on establishing the amount of nitrous oxide released from different farming systems and environments and investigating ways to lower the emissions from these systems. The research has not investigated the economics of the proposed abatement methods (for example, the use of nitrification and urease inhibitors) so the viability of these practices is not yet known.

The Victorian Department of Primary Industries (DPI) and Dairy Australia are investigating mitigation of nitrous oxide emissions in urine patches from animal production systems under the NORP. See the reference list under NORP for the link to a comprehensive list of the projects being investigated under the program.

### Current level of adoption

There is no current adoption of nitrous oxide mitigation practices as an official abatement practice is not yet in place. For example, the potential adoption of nitrification inhibitors will depend on the cost of the inhibitors compared to the value of the carbon credits generated.

### Industry activity

None at this stage.

### Carbon benefits

Currently none.

### Co-benefits

- Reducing N<sub>2</sub>O emissions improved efficiency of fertiliser use, that is, more

fertiliser was converted to production rather than wasted via nitrous oxide and nitrate leaching. In animal systems, a more efficient use of dietary nitrogen will lead to more productivity per unit of feed.

- Commercial potential: early results indicate that nitrification inhibitors can lower N<sub>2</sub>O emissions with varying levels of success across different agricultural systems. For example, laboratory-based research by the NORP found that applying a nitrification inhibitor lowered N<sub>2</sub>O emissions by 14 to 98 per cent across a range of soil types. Applying the same nitrification inhibitor to a ryegrass pasture system in south-western Victoria lowered N<sub>2</sub>O emissions by 73 per cent compared to urea application alone. However, these reductions are not economically viable given the current cost of nitrification inhibitors.

### Opportunities

- All cropping soils may benefit if the cost of nitrification inhibitors decreases.

### Risks

- There is currently no official methodology via the ERF associated with lowering nitrous oxide emissions from agricultural soil.
- To attract ERF accreditation, nitrous oxide abatement methods need to be considered as 'additional' (that is, not common practice) so it is unlikely that practices such as substituting legume nitrogen for inorganic nitrogen would attract accreditation.
- Soil carbon content is a driver of nitrous oxide emissions so pursuing soil carbon sequestration will work against nitrous oxide abatement. Conversely, pursuing nitrous oxide abatement could work against soil carbon sequestration. The whole system must be considered to ensure that its total carbon footprint is lowered, not just one aspect of it.

### Key contacts – Australia

- Nitrous Oxide Research Program: a national program led by Professor Peter Grace, Queensland University

of Technology, with research nodes in Victoria, Western Australia and NSW.

- Associate Professor Louise Barton (UWA)

## International work

- Massey University in New Zealand is investigating plant and animal management, diet formulation and feeding systems to reduce nitrous oxide emissions from dairy systems.

## Stakeholders

- Farmers
- Carbon trading companies
- Fertiliser companies
- State government agencies (Department of Agriculture and Food, Western Australia; Department of Environment and Conservation)
- Universities
- Regional groups

## Key references

An overview of the findings of the NORP research can be found in an eight-minute video and transcript) on the Department of Agriculture, Fisheries and Forestry (DAFF) website at: [daff.gov.au/climatechange/climate/communication/factsheets-case-studies-and-dvds/transcripts/transcript-of-the-nitrous-oxide-research-program-norp-southern](http://daff.gov.au/climatechange/climate/communication/factsheets-case-studies-and-dvds/transcripts/transcript-of-the-nitrous-oxide-research-program-norp-southern)

Barton, L, Butterbach-Bahl, K, Kiese, R & Murphy, DV 2011, 'Nitrous oxide fluxes from a grain-legume crop (narrow-leafed lupin) grown in a semi-arid climate', *Global Change Biology*, vol. 17, pp. 1153–1166

Barton, L, Murphy, DV, Kiese, R & Butterbach-Bahl, K 2010, 'Soil nitrous oxide and methane fluxes are low from a bioenergy crop (canola) grown in a semi-arid climate', *Global Change Biology Bioenergy*, vol. 2, pp. 1–15

Biswas, WK, Barton, L & Carter, D 2008, 'Global warming potential of wheat production in Western Australia: a life cycle assessment', *Water and Environment Journal*, vol. 22, pp. 206–216

Barton L, Kiese, R, Gatter, D, Butterbach-Bahl, K, Buck, R, Hinz, C & Murphy, DV 2008, 'Nitrous oxide emissions from a cropped soil in a semi-arid climate', *Global Change Biology*, vol. 14, pp. 177–192

Barton, L & Schipper, LA 2001, 'Nitrous oxide emissions from soils irrigated with dairy farm effluent', *Journal of Environmental Quality*, vol. 30, pp. 1881–1887

Dalal, RC, Weijin, W, Robertson, GP & Parton WJ 2003, 'Nitrous oxide emission from Australian agricultural lands and mitigation options: a review', *Australian Journal of Soil Research*, vol. 41, pp. 165–195

Li, Y, Barton, L & Chen, D 2012, 'Simulating response of N<sub>2</sub>O emissions to fertiliser N application and climatic variability from a rain-fed and wheat-cropped soil in Western Australia', *Journal of Science of Food and Agriculture*, vol. 92, pp. 1130–43

Nitrous Oxide Research Program, [daff.gov.au/climatechange/australias-farming-future/climate-change-and-productivity-research/emissions\\_reduction2/nitrous\\_oxide\\_research\\_program](http://daff.gov.au/climatechange/australias-farming-future/climate-change-and-productivity-research/emissions_reduction2/nitrous_oxide_research_program)

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