

## Reducing Nitrous Oxide Emissions when Fertilising Hay Crops with Nitrogen Fertiliser

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### INTRODUCTION

There has been increased global awareness of greenhouse gas emissions in recent decades from agricultural systems. Greenhouse gases, such as carbon dioxide, methane and nitrous oxide, trap solar radiation in the upper atmosphere, warming the Earth in a similar way to how a greenhouse traps heat under glass. This is driving global warming, which is slowly altering sea levels and weather patterns. To combat this, Australia has signed international agreements with other countries to actively reduce future emissions.

Reducing nitrous oxide emissions is a key concern as they have almost 300 times more warming potential than carbon dioxide. The Department of Primary Industry and Fisheries (DPIF) has started quantifying nitrous oxide emissions from soil in hay and horticultural products in tropical northern Australia. Nitrous oxide emissions from these industries form only a small part of Australia's overall emission rate; however there is growing pressure to reduce emissions across all sectors. Better understanding of emissions and how to abate them is creating opportunities for farming industries to participate in funded emission reduction studies and to prepare for future policies, which may regulate practices and technologies.

It is common practice in the NT to apply nitrogen fertiliser to grass hay crops. Plants do not use all of the applied nitrogen, with some being lost from the cropping system. Nitrogen movement through cropping systems is dynamic and it can be lost in many forms, such as nitrous oxide. This represents wasted money for farmers.

NT hay growers produce 43 000 to 83 000 tonnes (t) of hay on approximately 10 000 to 16 000 hectares (ha) per year. To achieve this production they apply between 50 to 200 kg of nitrogen fertiliser/ha (Cameron 2008). A recent NT study focused on the amount of nitrogen lost to the atmosphere as nitrous oxide.

DPIF's project "Reducing Greenhouse Gas Emissions through Improved Nitrogen Management on NT Farms" quantified gas fluxes from hay crops and tested the potential of enhanced efficiency fertilisers to reduce emissions. Enhanced efficiency fertilisers contain nitrification inhibitors that are designed to suppress soil microbes, which convert the nitrogen in fertilisers, such as urea, to nitrous oxide. When nitrification inhibitors are applied with urea, they slow the conversion of ammonium to nitrate, which reduces the loss of nitrous oxide to the atmosphere and leaves more nitrogen available for plant uptake. The impact of a legume crop to supply organic nitrogen to the soil when grown in rotation with hay was also measured. In each trial, the effects on crop yield, hay quality, nitrogen utilisation and soil nitrous oxide emissions were measured.

### METHOD

The project covered three wet seasons: 2012-13, 2013-14 and 2014-15. The first two years focused on Sabi grass (*Urochloa mosambicensis*) at Katherine Research Station and the third year on Jarra grass (*Digitaria milanjiana*) at a commercial property in the Douglas Daly region.

The enhanced efficiency fertiliser 'Urea with ENTEC<sup>®</sup>' was tested. ENTEC<sup>®</sup> is a nitrification inhibitor containing the active ingredient 3,4-dimethyl pyrazole phosphate (commonly known as DMPP). The nitrification inhibitor

Nitrapyrin was also tested, as a surface foliar spray. Nitrapyrin is available as a liquid concentrate for application as a diluted solution concurrent with fertiliser use.

These treatments were applied at various rates and compared with the same rates of regular urea fertiliser and an untreated control. In the second year, the trial was preceded by a year's crop of the legume *Cavalcade* (*Centrosema pascuorum*) to determine the effect of the residual organic nitrogen in the soil on crop production.

## RESULTS

Greenhouse gas emissions from soils in the NT increase immediately after application of fertiliser. Compared with urea use at equivalent rates, ENTEC<sup>®</sup> fertiliser had 61% less nitrous oxide emissions than normal urea in the first year and 25% less in both the second and third years. Nitrapyrin was less effective, reducing emissions by only 19%.

Hay quality and production did not differ across all fertiliser treatments. Statistical analysis showed no significant differences in yields. Conventional urea fertiliser is more economical than ENTEC<sup>®</sup> and Nitrapyrin at the same rates, but has greater nitrous oxide losses. Applied at 80 kg/ha in the first year, urea cost \$55.20/ha, whereas ENTEC<sup>®</sup> and Nitrapyrin cost \$73.60 and \$87.70/ha, respectively. The average yield of dry hay/ha for urea was 10 t, compared with 8.6 t for ENTEC<sup>®</sup> and 7 t for Nitrapyrin.

It was shown in the second year that the amount of organic nitrogen supplied to the soil following a one-year Cavalcade pasture was adequate for the production of Sabi grass. There were no significant differences in average yield between the control and the ENTEC<sup>®</sup> treatments, applied at 80 kg/ha. They produced 8.3 t and 9.4 t dry hay/ha, respectively. This suggests that the cost of adding fertiliser following a legume crop is not economically justified. Future trials will explore this point more extensively.

## CONCLUSIONS

This project found that enhanced efficiency fertilisers can minimise atmospheric losses of fertiliser and reduce nitrous oxide emissions whilst maintaining hay production. However, the cost of the fertiliser compared with urea is not yet economically viable.

DPIF now has valuable data as a benchmark for future studies on enhancing nitrogen utilisation and reducing nitrous oxide emissions in hay crops in the NT.

## ACKNOWLEDGEMENT

This project was funded by DPIF and the Australian Department of Agriculture, Fisheries and Forestry, Carbon Farming Futures – Action on the Ground Program.

We acknowledge contributions of Stuart Smith and Arthur Cameron of DPIF, to this project and publication.

## REFERENCES

Cameron, A 2008, Fertilisers for Grass Pastures, Agnote, No. E60, Northern Territory Government



**Figure 1.** Bio-baling Sabi grass at Katherine Research Station