AMMONIA LOSS REDUCTION

Research report: Evaluation of EF_1 and $Frac_{GASF}$ for N fertiliser and farm dairy effluent (FDE)

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Abstract

Ammonia loss from urea represents an economic loss to farmers and also contributes to New Zealand's greenhouse gas inventory. A reduction in both of these factors would be beneficial, and may be achieved by the use of urease inhibitors, e.g. in the form of SustaiN.

Trials conducted by AgResearch at five locations throughout New Zealand showed that ammonia volatilisation from urea was reduced by an average of 68% (range 36-86%) when SustaiN was used in preference to urea, at applications of 50 kg N/ha made in spring.

The results from this study support a much wider body of research into the efficacy of nBTPT, the active ingredient in SustaiN, which show the average volatilisation reduction achieved by nBTPT to be 45%. The results also provide further support for the effectiveness of SustaiN at reducing volatilisation losses in cool-season conditions in both North and South Island settings.

Introduction

Ammonia loss from urea through volatilisation has two distinct consequences. On the one hand, the nitrogen in ammonia lost by this mechanism is no longer available for plant uptake, representing a potential economic loss for the farmer. On the other hand, ammonia losses from nitrogen fertilisers contribute to New Zealand's greenhouse gas production.

Although ammonia itself is not a greenhouse gas, it has two potential environmental effects when it is redeposited. It may land on sensitive areas such as rivers, lakes and forests, causing unwanted side effects. In addition, a portion of the ammonia will later be released as nitrous oxide (N_2O), regardless of where it is deposited. N_2O is a greenhouse gas and contributes directly to New Zealand's inventory.

An understanding of the size of ammonia losses from nitrogen fertiiser and the effect of mitigation strategies such as the use of urease inhibitors may help to reduce New Zealand agriculture's exposure to greenhouse gas emissions.

Numerous studies on the efficacy of the urease inhibitor nBTPT (the active ingredient in SustaiN) have been conducted. The research in this study was carried out primarily to quantify the potential reduction in $Frac_{GASF}$ that could be implemented by using SustaiN instead of urea, and also whether allophane in soils affected the efficacy of nBTPT. ($Frac_{GASF}$ is the fraction of urea fertiliser nitrogen lost through the emission of ammonia gas – it is set at 10% in the New Zealand greenhouse gas inventory, with a reduction to 5.5% if SustaiN is used.)

Methods

Seven field plot experiments (2012 – Waikato, Otago; 2013 – Waikato, Manawatu, Canterbury, Otago) were conducted. Each site received spring applications of either urea or urea plus nBTPT (SustaiN) at a rate of 50 kg N/ha. An untreated control was also included. Six replicates of each treatment were laid down at each site. Ammonia emissions from each site were measured over the subsequent 22 days.

Results

Ammonia emissions from urea ranged from 11.2-23.9% of the N applied, with an average of 15.2%. Ammonia emissions from SustaiN ranged from 1.6-14.9%, with an average of 5.4%.

The reduction of ammonia loss by using SustaiN in preference to urea ranged from 36% to 86%, with an average of 68%.

Figures 1 to 7 show the cumulative ammonia loss from both treatments for the seven test sites.

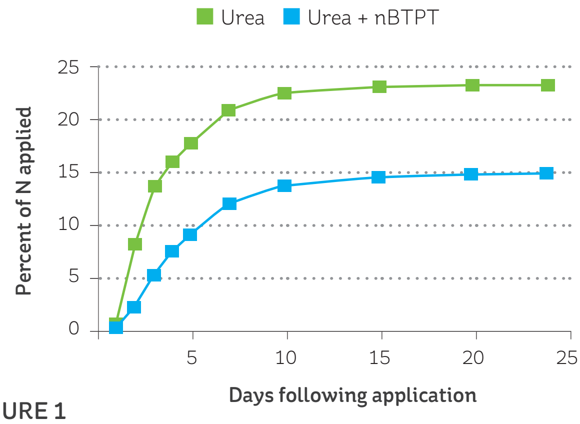

FIGURE 1
Cumulative ammonia loss at the spring 2012 Waikato allophanic soil test site

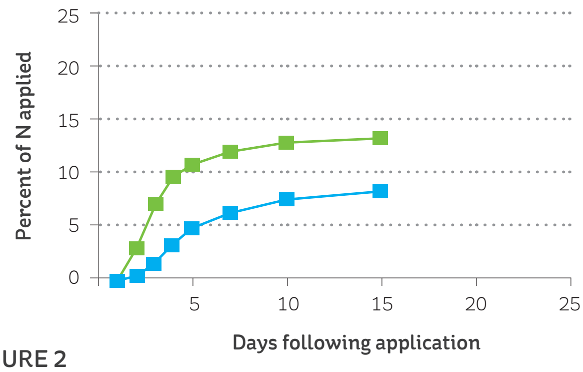

FIGURE 2
Cumulative ammonia loss at the spring 2012 Otago non-allophanic soil test site

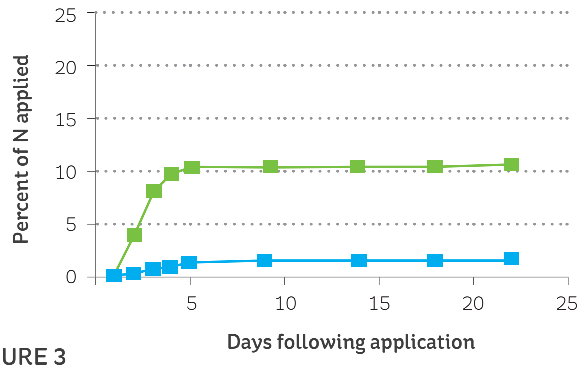

FIGURE 3
Cumulative ammonia loss at the spring 2013 Waikato allophanic soil test site

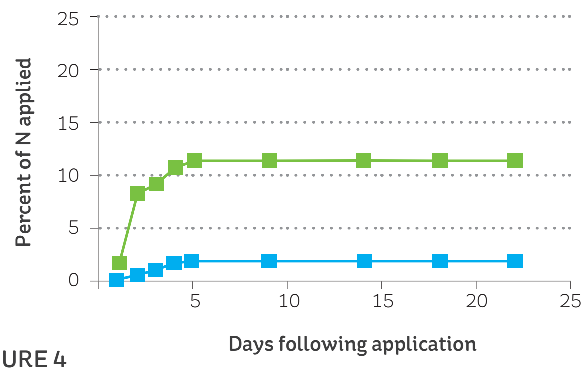

FIGURE 4
Cumulative ammonia loss at the spring 2013 Waikato non-allophanic soil test site

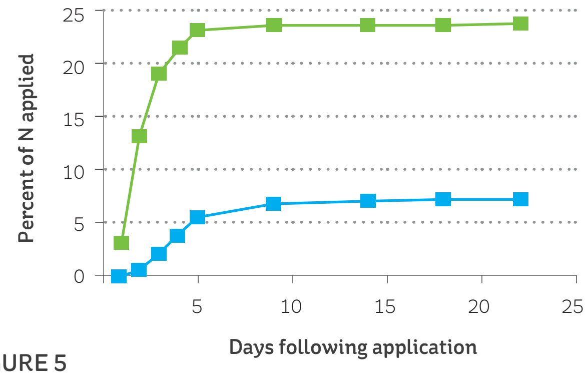

FIGURE 5
Cumulative ammonia loss at the spring 2013 Manawatu non-allophanic soil test site

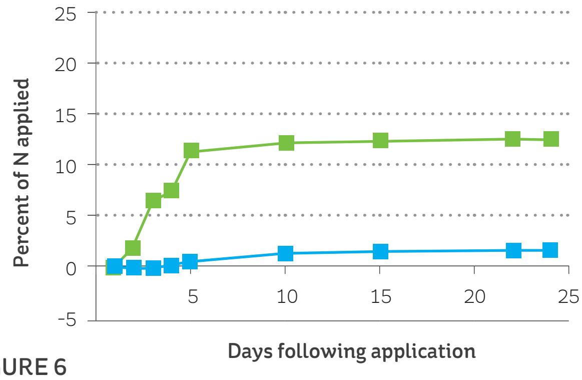

FIGURE 6
Cumulative ammonia loss at the spring 2013 Canterbury non-allophanic soil test site

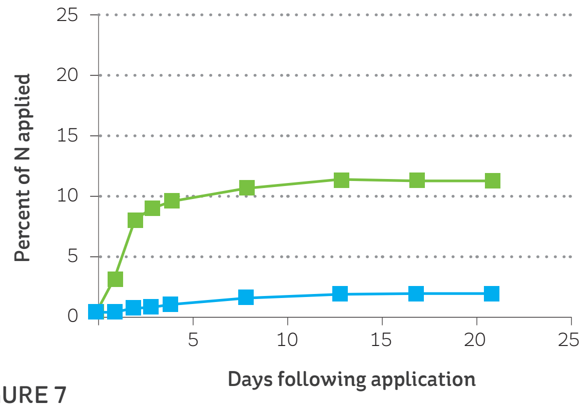

FIGURE 7
Cumulative ammonia loss at the spring 2013 Otago non-allophanic soil test site

Discussion

These results are consistent with other research, which has shown that ammonia losses from urea applied at pastoral rates are typically 10-20%. The data also agree with previously published research into the efficacy of nBTPT at reducing ammonia volatilisation losses in a pastoral setting. As such, it supports the existing $Frac_{GASF}$ value of 5.5% for SustaiN.

Furthermore, this work corroborates other research showing that volatilisation is not solely a warm-season phenomenon, as these trials were conducted in relatively cool conditions (early September and early October).

While it has been suggested that the allophane content of soils may influence the effectiveness of urease inhibitors, no evidence for this was seen in this trial.

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