

A LABORATORY METHOD TO SIMULATE FIELD LOSSES OF APPLIED NITROGEN FERTILISER BY VOLATILISATION

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Abstract

Recent work in the South African sugar industry has indicated how losses of nitrogen may be limited by using a simple soil test to determine the probability of losing urea-N via volatilisation. Where a danger of loss is indicated, alternative N carriers such as limestone ammonium nitrate (LAN; 28% N) or ammonium sulphate (AS; 21% N) are recommended, albeit at a higher cost per unit N. To further investigate the potential losses of N applied to sugarcane soils, incubations (at 25°C) were carried out using 3 kg of moist topsoil (12% clay; 1% OM; pH 5.7) in 5 L containers. Nitrogen fertiliser materials (urea, LAN and AS) were applied at rates equivalent to 160 kg N/ha, directly to the bare soil surface or onto a layer of sugarcane crop residue (simulating 10 t/ha).

On bare soil 15.8 kg N/ha (or 10%) of the urea-N was lost by volatilisation; by comparison, the losses of LAN-N and AS-N were negligible. Loss of urea N applied to sugarcane trash was 46.8 kg N/ha (29%), whilst the losses of LAN-N and AS-N were minimal (<1%). The method has confirmed the substantial losses of N that are likely to occur when urea is applied to some sugarcane soils, particularly where there are crop residues on the soil surface. Under such conditions, it is advisable for growers to use alternative N carriers.

Keywords: sugarcane, nitrogen, fertiliser, urea, volatilisation

Background

In the South African sugar industry, growers commonly apply nitrogen in the form of urea due to its high N concentration (46%) and relatively low price per unit N. However, under some conditions there is a danger of loss due to volatilisation as NH₃-N, particularly as the urease enzyme, which catalyses the hydrolysis of urea to ammonium bicarbonate, is commonly present in soils and plant residues of sugarcane. Recent work has indicated how losses of N may be limited by using a simple soil test to determine the probability of losing urea-N via volatilisation (Schumann, 2000). Where a danger of loss is indicated, alternative N carriers such as limestone ammonium nitrate (LAN; 28% N) or ammonium sulphate (AS; 21% N) are recommended, albeit at a higher cost per unit N.

Methods

To further investigate the potential losses of N applied to sugarcane soils, incubations at 25°C were carried out using 3 kg of moist topsoil (Fernwood form: 12% clay; 1% OM: pH 5.7) in 5 L containers. Nitrogen fertiliser materials (urea, LAN and AS) were applied at rates equivalent to 160 kg N/ha, directly to the bare soil surface or onto a layer of sugarcane crop residue (simulating 10 t/ha). The treatments were arranged in a randomised block design with four replications. The atmosphere from the containers was drawn out through acid traps, which were removed and replaced every 3-4 days over a one-month period, and the N within them determined using a steam distillation method. On each occasion that the traps were removed, water was applied as a mist to the soil surface, in order to replace lost moisture and simulate the effects of rainfall, which assisted in fully dissolving the fertiliser materials over the first two weeks of the experiment.

Results

On bare soil 15.8 kg N/ha (or 10%) of the urea-N was lost by volatilisation; by comparison, the losses of LAN-N and AS-N were negligible (Figure 1). Loss of urea N applied to sugarcane trash was 46.8 kg N/ha (29%), whilst the losses of LAN-N and AS-N were minimal (<1%). Most of the volatilisation losses occurred within the first two weeks of the experiment, with rates of loss being as high as 6 kg N/day where urea was applied to the trashed soil (Figure 2).

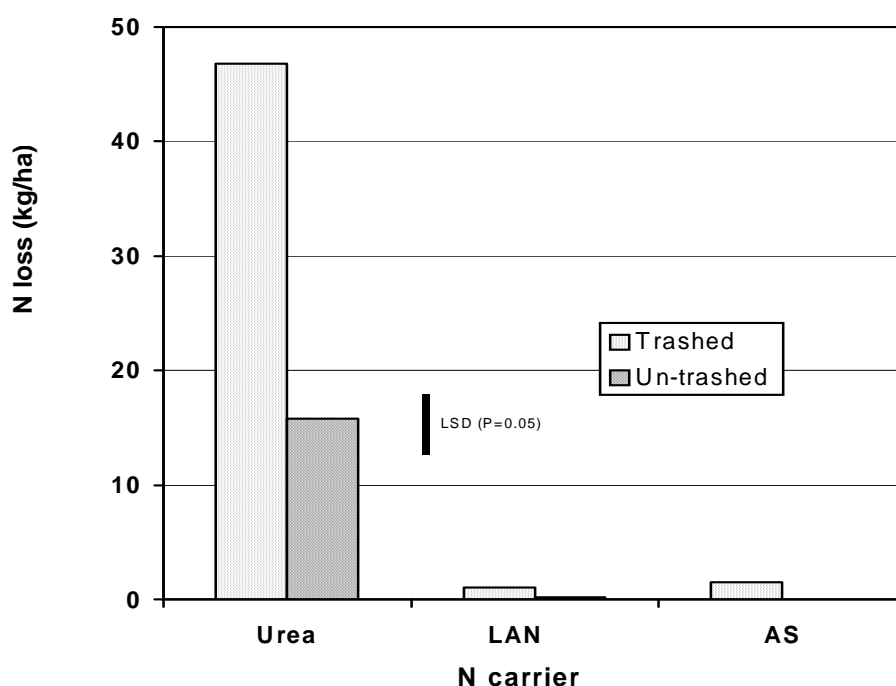


Figure 1. Cumulative loss of nitrogen (kg/ha) by volatilisation over a one-month period from three fertiliser materials (urea, limestone ammonium nitrate (LAN) and ammonium sulphate (AS) applied at a rate of 160 kg N/ha to trashed and bare soil.

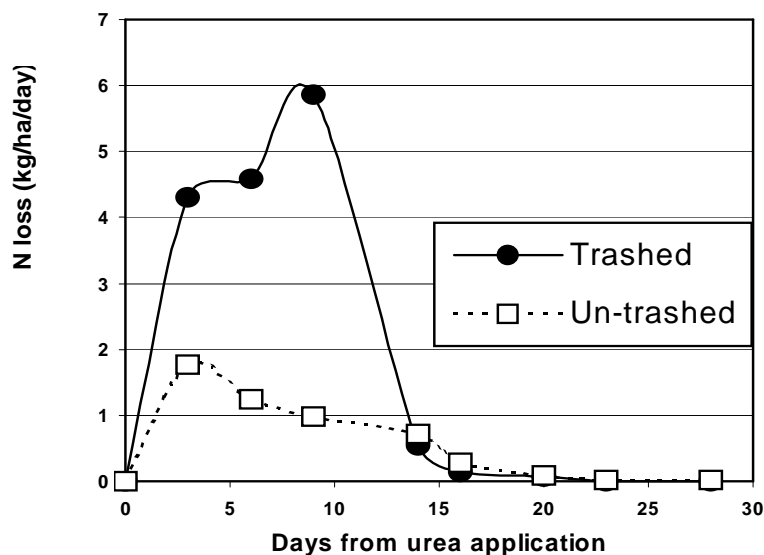


Figure 2. Rate of nitrogen loss (kg N/day) over time from urea applied at a rate of 160 kg N/ha to trashed and bare soil surfaces.

Conclusion

The method has confirmed the substantial losses of N that are likely to occur when urea is applied to some sugarcane soils, particularly where there are crop residues on the soil surface. Under these conditions it is therefore advisable for growers to consider using alternative N carriers. Future work will be conducted to further investigate this issue.

REFERENCE

Schumann AW (2000). Prospects for improving nitrogen fertiliser use efficiency with a new soil test and ammonia volatilisation model. *Proc S Afr Sug Technol Ass* 74: 70-78.