

F.A. Nicholson, M. Gibbons, A. Bhogal, E. Lord, R. E. Thorman, J. R. Williams*, K. A. Smith, T. Misselbrook, D. Chadwick and B. J. Chambers

*ADAS Boxworth, Battlegate Road, Boxworth, Cambridge, CB23 4NN, UK

Introduction

MANNER (MANure Nitrogen Evaluation Routine) version 3.0 has been a valuable tool helping farmers and advisors to quantify manure crop available nitrogen (N) supply, and to assess how changing the timing and method of manure application can affect N losses via ammonia volatilisation and nitrate leaching.

MANNER version5 (2008) incorporates more recent research information where significant advances have been made in our understanding of N transformations and losses following manure application to land.



Methodology

Ammonia loss algorithms for the selected manure types were modified to account for additional factors which have been shown to influence ammonia emissions, namely:

- slurry application method
- soil incorporation technique/timing
- land use
- application timing
- environmental conditions at the time of spreading (i.e. windspeed, rainfall and soil moisture content)

The manure organic N mineralisation function is now based on soil temperature and recognises N mineralisation differences between rapid (e.g. pig slurry/poultry manures) and slow (e.g. straw-based farmyard manure/cattle slurry) 'release' manure types.

A new module was added to estimate N losses via denitrification, as nitrous oxide (N₂O) and di-nitrogen gases. Although these losses are small in agronomic terms, N₂O is a powerful greenhouse gas.

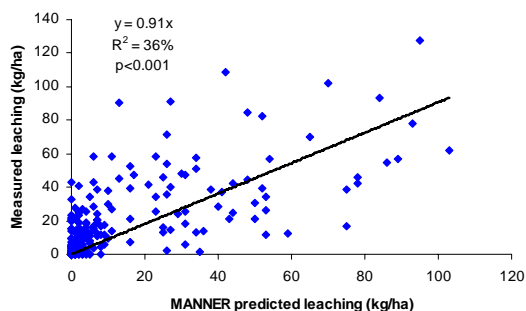
The nitrate leaching module in MANNER version5 (2008), was enhanced to improve predictions of losses from sandy soils (where leaching occurs via matrix flow) and to better represent losses from drained clay soils where water movement largely occurs via bypass (crack) flow. In addition, a nitrification delay was included to more realistically estimate when manure ammonium-N (following nitrification) was likely to be at risk from nitrate leaching loss. Autumn crop N uptake, which decreases the amount of N at risk from over-winter nitrate leaching loss is also accounted for.

Results

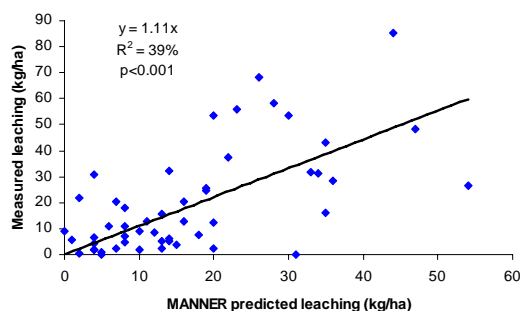
Validation of MANNER version5 (2008) nitrate leaching loss predictions was undertaken by comparing predicted values with independently collected field experimental measurements (>250 site years of data). For both sandy and clay soils, there was good agreement ($p < 0.001$) between predicted and measured nitrate leaching losses (Fig. 1). There was also good agreement between predicted and measured ammonia emissions, and predicted and measured manure crop available N supply.

Fig. 1. Predicted and measured nitrate leaching losses from free draining and drained clay soils (kg/ha).

a) Free draining (permeable) soils



b) Drained clay soils



Conclusions

Enhancements to MANNER enable the effects of manure applications on N losses through ammonia volatilisation, nitrate leaching and denitrification to be estimated, and potential 'pollution swapping' solutions to be assessed based on the latest scientific information.

Acknowledgements

Funding of this work by the Department for Environment, Food and Rural Affairs is gratefully acknowledged.