

**PREDICTION OF NITRATE LEACHING IN SANDY *REGOSOLS* USING
LEACHM -N**

BY

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ABSTRACT

There is evidence in both technical literature and the public media that leaching of nitrate from agricultural fields has led to economical losses to the farmers as well as caused groundwater pollution especially in sandy aquifers. Therefore leaching behaviour of NO_3^- -N was evaluated through laboratory and field experiments with those predicted by LEACHM-N. The leaching column study was performed to study the impact of three different irrigation (7, 14 and 30mm) and fertilizer treatments (0, 70 and 140 kg N/ha) in different depths of columns (20, 30 and 40cm) on NO_3^- -N losses and concentrations. Another objective of the column study was to obtain few input parameters for the model LEACHM-N through calibration.

Field experiments were carried out in a 350m² area, planted with onion, in Batticaloa, for "Maha" and "Yala" season. In a two season field study, nitrate-N (NO_3^- -N) leaching from the applied fertilizer nitrogen and bulb yields were compared applying the same fertilizer irrigation treatment combinations as used in the column studies. The NO_3^- -N leaching trends were compared graphically for all treatments to determine whether the trend of NO_3^- -N leaching was affected by the treatments applied. A field scale mathematical model, LEACHM-N, was used to simulate the leaching loss of NO_3^- -N.

The Break Through Curves (BTCs) in column experiments revealed that, the effect of advection is higher than that of diffusion in the nitrate transfer phenomena in sandy *regosols* when the rate of irrigation was high. Around 93 % loss was observed at

30mm/140 N treatment, whereas a minimum loss of 5.1% was obtained in 40cm column at 7mm/70N treatment. Leaching losses decreased with the increase in the depth of soil columns and at decreased irrigation rates.

The leachate flow weighted NO_3^- -N concentrations in all the treatments were below $10\text{mg NO}_3^- \text{-N L}^{-1}$ during *Maha* 2004, whereas in *Yala* 2005, it exceeded 10mg/l from most of the treatments. The treatment combination 30mm/ 70 N resulted in highest losses of 43.8 % and 95.1% during *Maha* 2004 and *Yala* 2005 respectively. Denitrification losses were higher in *Maha* 2004 due to the elevated water table and the saturated soil profile. Since the treatment combination 14mm/140 kg N/ha resulted in higher yield of 13,750 kg/ha and comparatively lower NO_3^- -N leaching loss of 30.3%, it was considered as a better fertilizer-irrigation combination for sandy *regosols*. Statistically, the treatments affected NO_3^- -N leaching in both seasons ($P < 0.0001$). However there was no fertilizer and irrigation interaction effect in *Maha* 2004 ($P = 0.4$), because the rainfall masked the effect of irrigation treatments. Fertilizer and irrigation interaction effect was significant in *Yala* 2005 ($P < 0.0001$) at 95% probability level.

Calibration of LEACHM-N yielded a value of 20.0mm for dispersivity. LEACHM-N produced satisfactory predictions in 20cm column. The accuracy of prediction was found to be decreasing when the column depth was increased and the rate of irrigation was decreased. In field experiments, LEACHM-N predictions were more acceptable in *Maha* compared to *Yala*. But the losses were under estimated in *Maha* and over estimated in *Yala*. The most accurate prediction of NO_3^- -N losses by

LEACHM-N was at 30mm/70N treatment combination in *Maha* 2004 (24.1 vs 24.6 kg/ha). Differences in measured field data and model outputs for other treatments were likely due to uncertainties and errors in some of the input parameters and measured data.

Sensitivity analysis indicated that the effect of nitrogen transformation rate constants had strong influence on NO_3^- -N leaching simulation. The simulation results at different scenarios show that this validated LEACHM-N model could serve as a tool to evaluate better management of surface applied N fertilizer in sandy *regosols*.